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TO ADVERTISERS

CHANGES for advertisements should be in this office by Friday noon for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than Monday noon to ensure publication in that week's issue.

With the next issue of the ELECTRICAL REVIEW the publication of Professor W. E. Goldsborough's serial on "The Theory of Alternating Dynamo Electric Mechanism" will be resumed, the forthcoming part of the discussion dealing more directly with the problems of dynamo design and construction. The application of the principles, already worked out by the novel and simple graphical method employed by the author, to actual conditions of construction will be found highly interesting and also of considerable practical value. This series of papers has attracted no little attention already, and has been used as a text in electrical engineering classes with excellent results.

THE WIRELESS TELEGRAPHY SITUATION.

An international conference on the subject of wireless telegraphy seems to be inevitable. This situation is, to say the least, curious, and is brought about by a variety of circumstances, among them the conflicting claims of a number of inventors and adapters and by the very nature of this method of signaling which makes use of no fixed plant for the transmission of its messages but uses the universal ether.

The status of an ocean cable is dependent, outside of the physical conditions which govern its installation and its permanence, upon the attitudes of the governments in whose territory its ends lie, while the cable itself is particularly susceptible to injury and to destruction in the event of war or by hostile interference of any variety. The recent little war in which this country took part taught several lessons concerning cable cutting and the facility with which these organs of communication may be destroyed or incapacitated temporarily or permanently. Evidently a system of wireless communication can not be interrupted in this way, although the systems now in vogue appear to be equally vulnerable in other directions. It will be recalled that at the last international yacht races the reports sent in were confused and at times absolutely suppressed by the operations of a rival system in the same neighborhood. To-day it is claimed by several inventors whose names are given to systems of wireless telegraphy that a more or less perfect method of tuning or selective signaling has been developed, although up to now the details have not been made public. Until this is done it does not seem unwise to look somewhat askance at the claims so often made and so loudly reiterated without the kind of demonstration that appeals to the engineering fraternity.

An additional complication is introduced into the subject by the attitude of the German Government, which has apparently restricted its territory to the operations of one particular variety of wireless telegraph apparatus to the exclusion of others. Whether or not these systems will intercommunicate under ordinary circumstances is not known to the public, since no data have been given out by the various parties in interest. It is certain, though, that commercial communication can not be secured without some form of international sanction.

What is evidently coming is a long and hard-fought legal battle between the various patentees, although the fact that all the registered patents are believed by competent authority to be of little value may have an important bearing upon the litigation likely to ensue. It seems to-day as if some of the more spectacular results that have been obtained have been due to the use of secret methods, and not to those disclosed in the patents on file in the various patent offices.

The subject is one of considerable interest, though even with the recent advance in the art of signaling through space the commercial utility of the method is little, if any, more apparent than it was at the beginning, except in the single case of communication with vessels at sea. For military and naval purposes the value of wireless signaling will probably be much greater in time of peace than in time of war. The signals are so easily interfered with—that is, assuming that they are sent out by apparatus covered by the various existing patents—that a method of disturbing them analagous to the cutting of a cable would be extremely easy to apply. One fact that is lost sight of in most of the discussion concerning the utility of the new means of signaling is that selective or tuned systems will be of no earthly use for marine purposes. If a vessel in distress to-day was compelled to use rockets and flares and signal guns invisible and inaudible to vessels of any other line than its own, these appliances would

probably be thrown overboard as of too small value to warrant the trouble of carrying them along. It is so with the tuned system. What seems to be needed in sea signaling is a universally applicable method by which a vessel in distress could send out its call for help in such a way that it would be received by any other ship provided with any variety of wireless signaling apparatus that happened to be in range.

The subject is a curiously complex one and doubtless some time will elapse before much light is cast upon it. In the meantime the proposed international conference can certainly do no harm, and may result in the establishing of a new safeguard for those who travel by sea and the initiation of a system which takes no account of national boundaries, and hence may prove itself another and stronger link in the chain of mutual interests which is binding together the various nationalities.

THE ELECTRIC LIGHT CONVENTION.

The next convention of the National Electric Light Association, which is to be held at Cincinnati on May 20, 21 and 22, will be another of those interesting and valuable occasions which have marked the history of this extremely important organization. Indeed, from such information as has already come to hand, this year's meeting will probably be one of the best in the history of the body.

The National Electric Light Association was formed at a meeting held in Chicago in February, 1885, in response to a call issued by this journal. Even at that early day it was recognized that great good would result from the interchange of experiences by those engaged in the electric lighting industry, and that the nature of the business was such that these experiences could freely be exchanged to the great advantage of all parties concerned. The electric lighting industry was then only beginning to be of importance and prominence. It was hampered in many directions by adverse and ignorant legislation, by the ignorance even of those engaged in it, and by the lack of public appreciation of the value of the new illuminant. In order to promote mutual understanding, and the better to discuss and bring up various points of interest to electric lighting men, including new methods and new experiences, to throw new light on the conduct of the business and the relation of the companies to the public and to one another, the association was formed. From that day it has been one of the most potent and active bodies in the electrical engineering field and the good it has done to the industry it represents has been almost incredible. The meetings, now held annually at various cities chosen from year to year, have brought out papers and discussions of a high technical order and of the greatest value, while the great army of supply dealers and manufacturers' representatives have found it greatly to their advantage to attend these meetings and come into personal contact with the managing element of the electric lighting industry. On this account the conventions have taken on a new character and have become occasions at which the variety of new apparatus and new systems of methods are exhibited, while the papers instead of being the perfunctory performances too often usual at gatherings of the same general character have often possessed great distinction and high merit. This year will be no exception to the general rule, and it is expected that the meeting at Cincinnati will be one of the most instructive and attractive in the association's history.

It is now certain that the meeting will be very well attended, and all arrangements looking to the comfort and convenience of those in attendance have been perfected. The association has put the electric lighting fraternity under great obligations. What it has already accomplished is known to all engaged in the business. What it may accomplish in the future may be inferred from its past record and from the progressive and vigorous quality of its membership.

THE INSTITUTE AND ITS LIBRARY.

The American Institute of Electrical Engineers is now the possessor of one of the best electrical libraries in the world. A movement is actively on foot to provide a proper home for this excellent collection of books so that it may be made accessible to members and others desiring to consult it, and at the same time it is thought that a house will be bought or erected for the offices and meetings of the society and for the proper housing of the library.

It is safe to say that more than nine-tenths of the working members of the electrical profession in this neighborhood are located in the lower part of New York city. For this reason the installation of the library at some point in the residence section of the town will put it utterly out of reach of those to whom it naturally would be most useful. Uptown it would be out of reach of the busy engineer except after office hours, and the general experience has been that libraries are not consulted after office hours by those to whom they would be of most advantage. For these reasons it seems best in deciding the question of locating the library that it should be placed as centrally as possible in the district of New York which has been selected as the headquarters of the engineering profession.

There is a growing tendency in the Institute to make more of the purely social side of its meetings. While receptions and dinners and *conversaziones* are excellent things in their way, and doubtless do much to improve the *esprit de corps* of the Institute, still it should not be forgotten that the function of this body is to advance electrical engineering and not social matters. What will endure after the present membership of the Institute is dead and buried are the transactions, which will be filed in libraries in permanent shape to last as long as the paper and binding of the volumes hold together. For this reason too much attention can not be paid to the preparation of papers, to the introduction of topics of vitality and importance, and to their discussion in the proper spirit. The Institute should represent the best in American electrical engineering and to present a paper before it should be counted a high honor. Contributions of a purely perfunctory character are neither desirable nor useful.

Without any intention to reflect upon the way things have been going for some time past, it seems as if the time has arrived to inaugurate an improvement in regard to the class and character of the papers

and discussions presented before this body. While receptions and the like are ephemeral and are important only while they are going on, the papers presented are the groundwork upon which the future of electrical engineering advance in this country must largely rest. Even a library, important as it is, is totally secondary to the current transactions, meetings, papers and discussions. These things are the raw material out of which future books are to be made.

A NEGLECTED BRANCH OF STUDY.

The function of the school is to prepare the scholar for his life work. In order best to attain this end a variety of subjects are necessarily taught, and these are differentiated with regard to the probable demands of the student's future business in life with more or less degree of success and skill. In the United States there are to-day a large number of technical, engineering and scientific schools whose function it is to prepare students to enter upon successful careers in the branches of activity bearing the same names, and whose curricula are planned with reference to teaching the largest amount of science and engineering that can be compressed into the time at the student's disposal. In order to do this the majority of these schools have found it necessary to omit from their courses a number of studies which were formerly regarded as of the first importance in a liberal education.

No one can seriously doubt to-day that cutting off much of the time formerly spent in the study of classical languages is an advantage to the student. Similarly, no one can possibly doubt that instruction in modern languages other than the student's own tongue is of essential importance, seeing that much of the literature of engineering and scientific subjects must necessarily be written in other languages than that to which the student is born; but, in this country especially, the teaching of languages, English included, has been sadly neglected in technical and scientific institutions. It is to this neglect and its consequences that it is desired to call attention.

A man may have the most comprehensive and complete knowledge of his subject and may be very expert in it, but without the ability to express himself clearly and distinctly and unmistakably he suffers a handicap so severe that only a great genius can overcome it. The art of expression—that is, the art of speaking or writing what one has to say in concise, logical and unmistakable language—is one of almost priceless value, and more particularly and especially to engineers than to almost any other class of the community. The value of an engineering report does not depend so much upon the erudition and the familiarity with the subject exhibited by the engineer making it, as it does upon his ability to make clear and explicit his reasons, to show logically the origin of his deductions, and to impress others with his conclusions. It is precisely this art which has been neglected, this training in rhetoric and logic.

We are a careless people. Perhaps more than any others we are willing to condone faults of expression if we are sure that the man committing them is correct in his general principles. We do not ask for correct grammar so long as the facts and the statements concerning them are correct; but the habit of slipshod and illogical expression necessarily begets a similarly illogical and slipshod mental attitude. The man who can not express himself in a straightforward and concise way is apt not to be able to think straightly and clearly. Training, then, in the art of expression is of a twofold value, in that it also trains the mind of the student to run in logical channels and to act with precision and clarity upon problems presented to it. This training is noticeably lacking in many engineering graduates whose experience has certainly been sufficient to qualify them in other regards.

The systematic study of English and of expression in it would be an infinite help to engineering students. These men are dependent upon their ability to make clear and accurate statements. They must commit themselves indefinitely in their future reports and writings. They will have observations to make and conclusions to draw from them, and a very large proportion of the value of these conclusions and observations will be dependent upon the language in which they are stated. Facility in the use of language is a tool in the hands of a competent man with which he can accomplish much. Mere knowledge without this facility is practically useless.

For these reasons the teaching of English is commended to the authorities of technical schools and colleges for their thoughtful consideration. Even in theses for graduation at some of the prominent engineering schools there has been often noticeable a lack of clear expression, a failure in logical deduction and an uncertainty in the choice of terms which all too frequently come near to destroying the value of the student's work. This state of affairs should not be allowed to go long unremedied. To show the value of the art of expression one has only to note that Darwin's "Origin of Species," for example, has found thousands and perhaps millions of popular readers, and has impressed upon the whole period a belief in the author's conclusions—largely on account of the fact that the work is a masterpiece of pure and limpid English. If it had been written in the style of some of the papers read during the last few years before American engineering societies and printed in our technical journals, it is doubtful whether or not it would have attracted even passing public attention.

It is an almost notorious fact that the standard of English permissible in college entrance examinations, and far too often throughout the course, has fallen low. With the innumerable variety of subjects with which the mind of the ordinary schoolboy is burdened, far too little stress has been laid of late upon teaching him how to say and how to write things in his mother tongue that will carry with them clearness and conviction. Perhaps the fault does not lie wholly with the technical institution, but is shared by it with the primary school and the high school. At any rate, the fault is apparent and a remedy is needed. It should be found in instruction given in college and university, in technical school and institute, in the art of expression. A student should not be taught only the lessons of his text-books and laboratory experiments, he should be taught as completely to express what he has learned in concise figures and utterly unmistakable language, thus cultivating in him a habit of thought which will be of infinite worth to him by rendering doubly and trebly valuable anything of importance that he may ever do in his subsequent career.

ELECTRIC FURNACES.

BY BERTRAM BLOUNT.

(*Concluded from page 560.*)

In the second type of Cowles furnace hoppers and a tapping hole are provided. They serve not merely for charging and drawing, but also for altering at any given point the amount of resistance material on the hearth, and thus controlling the heating effect of the current, and causing it to be approximately uniform from end to end. The idea of making the charge itself act as the resistance for converting

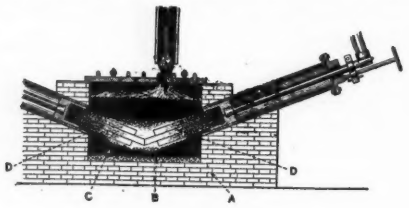


FIG. 8.—COWLES FURNACE FOR ALUMINUM BRONZE.

electrical energy into heat energy precisely at the place required was extended by the Brothers Cowles in the best-known form of their furnace, *viz.*, that which was employed for making aluminum alloys, especially those with copper. Here the granulated copper, mixed with the charge of alumina and carbon, serves as a semi-continuous conductor, the contact surface of the constituent parts of which offered sufficient resistance to ensure the production of much heat when a current was forced through. The ultimate outcome of their ingenuity is shown in Fig. 8, representing a furnace for making aluminum bronze. The parts are lettered similarly to those of the previous illustrations. This type of furnace was successfully used for some years, but at the best it would only produce aluminum alloyed with copper and generally containing iron and silicon as impurities. The Héroult apparatus, which produces unalloyed aluminum, soon replaced the Cowles furnace even for alloys, because it was found to be better to prepare a definite alloy by mixing the pure metals in an ordinary furnace as is done for brass, gun-metal and a host of similar alloys. It is interesting to note that in the series of Cowles patents there is one describing the use of charcoal with a wash of lime over the fragments composing the lining. The idea is elegant, and in the days when it was first set forth calcium carbide was barely known. If the packing of charcoal reached a temperature sufficiently high—and it probably did—there remains the doubt whether its limed surfaces would not be converted into calcium carbide and thereby become fusible and conductive.

Having thus traced the origin of the two dominant types of electric furnace, I will give a brief description of a few examples belonging to one or the other class which exhibit points of individuality and interest.

CALCIUM CARBIDE FURNACES.

The Wilson furnace differs but little from the vertical form of Siemens, but is worthy of notice, because it was employed in the early days of carbide manufacture, although originally intended for the reduction of aluminum, a purpose for which it was eminently unsuited. As will be seen from Fig. 9 its construction is of the simplest.

There is a casing of fire-brick, A, a carbon vessel, B, with a tapping hole, D, and a cover, E, through which passes a carbon electrode, C, adjustable in height. The charge is introduced little by little, and as it is heated fuses, forming a pool of cal-

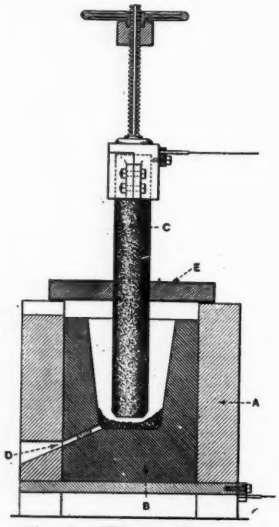


FIG. 9.—WILSON FURNACE.

cium carbide, acting as the electrode, between which and the carbon rod an arc is maintained. The tapping hole allows the fused product to be run off, and thus should permit the furnace to be worked continuously. For the successful attainment of this end, however, a considerable modification is needed, the hearth being much shallower and the tapping very frequent. The high fusing point of calcium carbide makes all continuous processes depending on its being run out from the zone of formation somewhat difficult to work. Thus it comes about that most carbide is "block" carbide.

Another furnace of a simple kind, which has been found fairly effective in practice, is shown in Fig. 10. A is a cast-iron box lined with thick carbon blocks, B. The cavity, C, constituting the furnace proper is rather shallow; it is provided with a tapping pole, E. The upper electrode, D, is a massive carbon rod of square section. The lower end is just clear of the top of the box and of the fused part of the charge, the liquid carbide filling the box. The raw materials (crushed coke and lime) are fed by hand into and around the arc which plays between the upper electrode and the carbide in process of formation. By judicious feeding the arc can be smothered to some extent, but even at the best a great part of it is exposed, and a considerable loss of heat results. The upper electrode can be gradually lowered as it is consumed. The chief merits of the furnace are its cheapness and simplicity, and the fact that it can be worked continuously, the carbide being allowed at intervals to flow out at the tapping hole, and fresh raw materials being supplied round the upper electrode. A certain amount of hand labor is required, but it is not of a severe character. It will be seen that this furnace is not unlike the Wilson furnace, but that no attempt is made to enclose the arc by the furnace walls. This is probably because in the Wilson furnace the walls being conductive themselves form one of the electrodes and get unduly hot. A non-conductive refractory material, such as magnesia, might turn the balance of advantage in favor of the Wilson form.

Another type of furnace is that designed to make "block" carbide. The King furnace is an example. (Figs. 11 and 12.) It consists of brick chamber, through the top of which the end of the upper electrode, C, passes; it is fitted at the bottom with a truck, A, which can be run into position and removed at will, and serves as the box to contain the carbide formed. The truck can be given a small

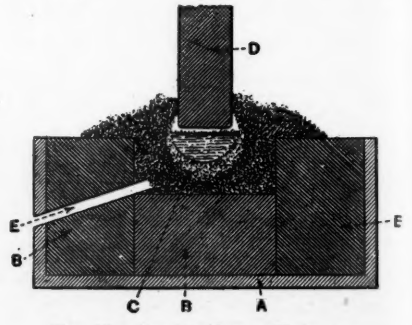


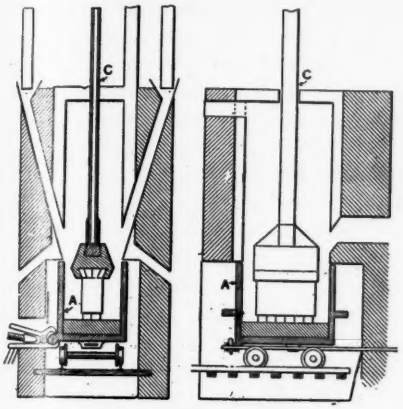
FIG. 10.—SIMPER BLOCK FURNACE.

reciprocating motion to help to shake down the charge, and to prevent the path of the current from being too localized. The raw materials are fed in little by little through side passages in the brickwork, and are exposed to the heat between the

electrodes. The upper electrode is slowly raised, and thus a block of carbide is gradually built up.

A second form of block carbide furnace is that used by the United Alkali Company at Widnes.

The distinctive merits of this furnace are that the upper electrode is continuously immersed in the raw materials, and that the vessel containing these is slowly rotated so as to bring every part of the charge into the zone of activity. Thus there is maintained a constant supply of raw material immediately beneath the upper electrode, and no arc can form. The furnace is of the resistance or Cowles type, and the waste involved by the use of an open arc is avoided. In this way a block of carbide is gradually built up by feeding in fresh raw material (which may be done mechanically) and raising the upper electrode. When the block is finished the operation is stopped, the front of the crucible opened, and the block removed. Adherent raw material from the sides and crude carbide containing admixed raw material from the top are knocked off, and the sound, well-fused block carbide broken up for packing.



FIGS. 11 AND 12.—KING FURNACE.

It will be observed that no attempt is here made to tap the carbide, and indeed it is doubtful whether this type of furnace could be used in this way without radical modification.

In general it may be said block carbide is inferior to tapped carbide, but that its manufacture is easier. There is more chance of the carbide made in blocks enclosing unconverted raw materials. It does not follow from this that the manufacture of block carbide is to be condemned. The inferiority of the product may be compensated for by a better utilization of energy, and if the carbide is bought on its assay value the consumer may be perfectly willing to buy the lower-grade product at a proportionately lower price.

There are many forms of carbide which, if examined with knowledge, might be grouped under one or other of the heads given above. It may be useful to consider on what lines a carbide furnace should best be constructed, and to attempt the design of such a furnace.

In the first place, the furnace should make carbide sufficiently fluid to be tapped and run away from the sphere of action. This requirement rules out block carbide and makes the furnace of the continuous type. Next, it should not have an exposed arc, and the heat electrically generated should be conserved as much as possible. Thirdly, it should be so constructed that the containing-vessel is hardly affected by the high temperature necessary to form carbide. I have endeavored to embody these ideas in the furnace illustrated in Fig. 13.

The furnace consists of a fire-brick casing, A, with a magnesia lining, B. The shape is conical, and at the bottom the furnace is contracted to form a hearth for the fused carbide. The tapping hole is at the bottom of this contracted part. The lower electrode is a carbon plate, C, and the upper electrode a massive carbon rod, D, of circular section. The raw material is fed into the annular space between the upper electrode and the magnesia lining in sufficient quantity to enclose and smother the zone of highest temperature. This feeding may be done mechanically, and various devices suggest themselves, but it is probable that hand feeding will be at least as effective, because the amount of labor required is not great, and the variation of conditions is so large that the greater elasticity of hand feeding may be a positive advantage. For the safety of the workmen it may prove necessary to draw off the carbon monoxide by a fan through a side flue, leaving the top of the furnace open and uninterrupted for manipulating the charge. In operating the furnace a pool of carbide will be formed and maintained of such depth as to cover the hearth and to allow of tapping the pure and fairly fluid product, but the depth of this pool will be kept small, and special attention will be directed to maintaining its fluidity by the means indicated below. It will be observed that the cross-section of that part of the furnace immediately surrounding the lower end of the upper electrode is considerably greater than the cross-section of the hearth on which the carbide collects. Thus the smaller section of the column of carbide compensates for its conductivity being greater than that of the raw materials; the desired temperature can be maintained, and the carbide will remain sufficiently fluid to be tapped.

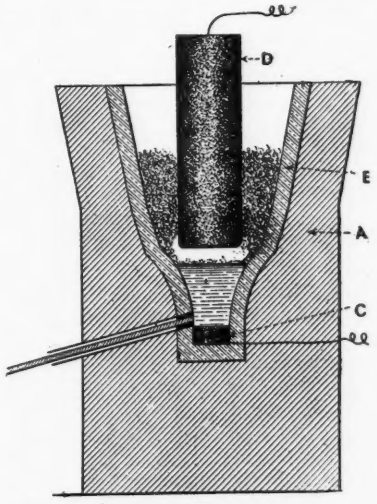


FIG. 13.—IMPROVED CARBIDE FURNACE.

It is evident that a furnace of this description, which is continuous and has a large part of its contents at so high a temperature as to be fluid, can hardly be worked on any system which depends on the raw materials forming a protective lining, for this, from the nature of the case, can not protect the hearth or crucible where a pool of fused carbide is always present. That part at least must therefore be protected by a refractory lining. Carbon might be used but for its conductivity, which would allow the current to reach the upper electrode without passing through the fused carbide, leaving this comparatively cool and liable to solidify. Magnesia is the most suitable material. It is not reduced by carbon, does not yield a carbide and is extremely infusible. It is not a good non-conductor of heat, but the difficulty thus caused can be overcome by supplying the lining with a backing of fire-brick, as shown in this figure. I am of opinion that this will be the type generally adopted as long as the carbide industry is at its present somewhat crude stage. If it is found feasible to heat the raw materials by non-electrical means to a point approaching the temperature of formation of carbide, then to raise them through the last 1,000 degrees centigrade or so electrically, to work regeneratively, and to utilize the by-product carbon monoxide, the aspect of affairs will be profoundly changed. Until then the

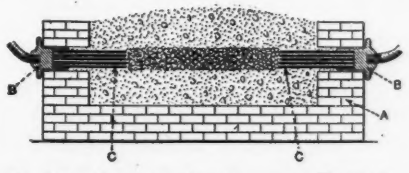


FIG. 14.—ACHESON CARBORUNDUM FURNACE.

simple type of furnace described may be considered as an attempt to meet present needs in a rational manner.

It is of considerable interest to manufacturers, more particularly those who have at their disposal large quantities of waste powder from blast-furnace gases, or the gases from recovery coke ovens, that a few weeks ago a decision was given in the law courts by which the manufacture of calcium carbide in the electric furnace has been declared public property in this country. Of course it is possible that an appeal may be entered against this decision, but I for one do not regard it as likely to succeed. As the matter stands at present, it has been held by Mr. Justice Buckley, in an exhaustive judgment, that the Wilson patent for the manufacture of calcium carbide is invalid for want of novelty. Those who have studied the question are aware that Moissan's discovery of the method of preparing calcium carbide in an electric furnace was published some time prior to the date of the patent, and this publication was so full and explicit that everything necessary for the industrial preparation of calcium carbide in the electric furnace was thereby disclosed. No doubt there will still be rights in particular forms of apparatus, but the broad fact that calcium carbide can be manufactured by heating lime and carbon together in an electric furnace has been publicly set forth and is open to every one to utilize.

The Acheson Carborundum Furnace—This furnace is of the resistance type, and differs from the Cowles by having a conductive core distinct from the charge to be heated. The general arrangement is shown in the figure (Fig. 14). The furnace is about fifteen feet by seven feet by seven feet, and is a rough brickwork structure, A, which can be taken down and easily reconstructed for each run. It is merely designed to keep the mass of raw material together, and to provide support for the electrodes. Each electrode is formed of a bundle of carbon rods, C, set in a heavy metal holder, B, by means of which the leads are attached. They project into the furnace, and between their ends is built up a core of broken coke, round which is packed the charge, consisting of 34.2 per cent of coke, 54.2 per cent of sand, 9.9 per cent of sawdust and 1.7 per cent of common salt. This charge weighs about ten tons, and if completely converted into silicon carbide (carborundum) should yield about four tons of this substance. The average quantity obtained per run is about two tons, therefore the yield is poor. A furnace such as that described will absorb about 1,000 horse-power, and take some thirty-six hours for a complete trip. It will be seen that the apparatus is rudimentary in its simplicity, yet it is hard to say in what manner it could be improved. The product, silicon carbide, must be prepared crystalline, and so it does not actually fuse, but rather is formed by the action of carbon on silica in the state of vapor, its preparation by any process involving settling out or tapping, as in making block carbide or tapped carbide, respectively, appears out of the question. Seeing that only one particular zone of temperature—*viz.*, that immediately surrounding the coke core—is sufficiently high to ensure complete conversion of the raw materials into silicon carbide, it follows that the heat in the outer layers must be chiefly wasted. At present the industry of making carborundum, though interesting and potentially important, is not so large as to have attracted much attention from inventors.

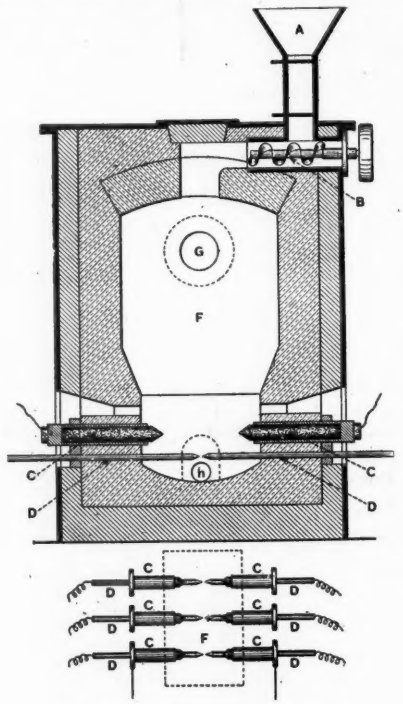


FIG. 15.—PARKER FURNACE.

The Manufacture of Phosphorous in the Electric Furnace—One of the most successful applications of the principle of the electric furnace is to the manufacture of phosphorous. For many years phosphorous was made by heating a mixture of phosphoric acid and carbon in small retorts set in an ordinary furnace, and, of course, heated externally. The heavy consumption of fuel and frequent breakage of retorts usual in such operations made the method expensive. It occurred independently to Dr. Readman and to Mr. Thomas Parker, in conjunction with Mr. Robinson, that the heating could be better accomplished electrically, and in 1888 patents were taken out by both inventors. Realizing that their interests lay together, the patentees joined forces, and a process resulted so far in advance of the older method of heating as to replace it completely. The Parker furnace, as originally patented, is shown in Fig. 15. It consists of a firebrick chamber, F, with a feeding hopper, A, at the top, so arranged that the charge can be introduced without allowing access of air, and a side flue, G, to carry off gases and vapors produced during the operation of the furnace. The lower part of the furnace is contracted to form a hearth, and the charge at this part is strongly heated by the passage of a current between two sets of electrodes, CC, placed opposite each other. The flow of the current is started by small pilot electrodes, DD, and when the charge has been heated by these the whole mass is maintained incandescent by the current passing between the main electrodes. By this device the heating is fairly well distributed over the hearth. Some method of this sort is requisite for phosphorous, as the intense local heating of the arc is neither necessary nor desirable. What is needed is a moderately high temperature applied internally and diffused through the considerable mass of material constituting the charge. Even with all such precautions it is not easy to heat a large furnace uniformly, and the units of plants are still relatively small. But in spite of this the real merits of internal heating are so great that the electrical process is now without a rival. Another form of phosphorous furnace is shown in Fig. 16. It is practically a Siemens crucible furnace, closed so as to prevent the exit of gases except through the determined outlet, D, through which the phosphorous distils. The upper electrode is water-jacketed. Another substance for the manufacture of which the electric furnace presents substantial advantages is carbon disulphide. The reaction between carbon and sulphur is endothermic, and it is evidently preferably to impress on the raw materials the requisite heat by an internal method of heating rather than to pour it in laboriously and expensively through the walls of a retort.

Electrical Roasting Furnaces—The furnaces which have been described above are from the nature of the case chiefly concerned in the production of high temperatures. When moderate temperatures —*e. g.*, up to a white heat about 1,400° C. = 2,552° F.—are required, gas or solid

fuel furnaces of well-known types are generally preferable, and certainly much cheaper under ordinary conditions. At still lower temperatures—for example, a moderate or a dull red heat—the case against the electric furnace is even stronger. One may, however, find instances when the use of the electric furnace is practicable for very moderate temperatures. Already low-temperature electric furnaces are in successful use for laboratory purposes, and for the little muffles employed in mechanical dentistry. I propose to extend their employment, given suitable conditions, to industrial operations. In modern metallurgical practice it not infrequently happens that an ore of paying richness occurs in a district where fuel is dear or hardly existent and the means of communication so bad that the cost of imported fuel becomes almost prohibitory by the time the fuel is delivered on the spot. Such desolate regions, from the nature of the case, are generally mountainous and often abundantly supplied with water power. The enterprising exploiter of a property of this kind naturally turns to some electrochemical process of treatment, and if the water power can be readily utilized without an unduly large expenditure for impounding, tunneling and the like, there is no reason why the absence of fuel should prevent the successful and profitable extraction of the valuable constituents of the ore. But it often happens that electrometallurgical processes need some preliminary aid from older methods. Frequently, for example, the ore has to be roasted.

In the case now being considered, as fuel is very dear, an alternative mode of heating is desirable, and this can be secured by an electrical method. The cost even with cheap water power would be excessive under ordinary industrial conditions, but in the special circumstances cited it may fall within moderate bounds.

As long ago as 1883, Faure patented a furnace, illustrations of which are here shown (Figs. 17 and 18), designed for raising the temperature of a charge lying on the hearth of the furnace by heat generated in a continuous conductor embedded in the sole of the furnace. An obvious alternative is to let the conductor lie on the hearth itself or to embed it partially. This furnace was intended for the manufacture of sodium, but, as far as I know, was never put into use. It will serve here as an example of a simple method of internally heating a reverberatory furnace suitable for roasting operations. It would be easy to devise other forms to meet special needs. The temperature required is so moderate that the practical difficulties are smaller than most of those encountered in electrochemical work. Without setting myself seriously to the design of such a roasting furnace, I should say that a fire-brick hearth in which grooves were chased so that iron rods of fairly large sections were embedded nearly flush with the level of the hearth would serve as well as more elaborate contrivances. I should use a low pressure and a heavy current, so that the

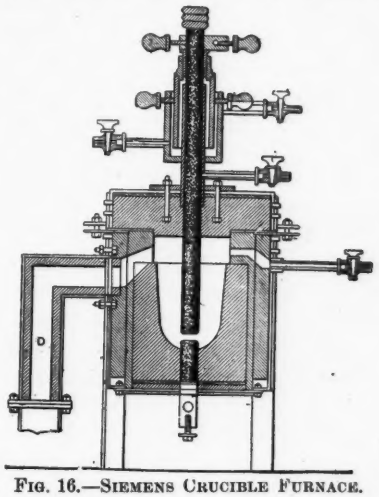
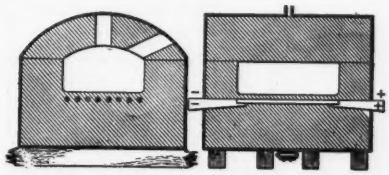


FIG. 16.—SIEMENS CRUCIBLE FURNACE.

iron rods might be stout enough to resist wear and loss by oxidation. They could be easily and cheaply renewed. Systematic roasting in a revolving calciner, instead of on a fixed hearth needing rabbles and much hand labor, would be accomplished at least as easily as any form of roasting by fuel in a similar apparatus. Roasting furnaces needing ploughs or rakes dragged over the hearth mechanically to stir the ore would be better suited by the electrical method of heating than by the usual roasting processes; the wear and tear of such form of mechanism is heavy, and is largely due to their exposure to the fire-gases which heat the ore. With an electrical roaster this would be changed, the sole of the furnace being the hottest part, the ore the next, and the plough, or stirrer, remaining fairly cool. There are certainly possibilities in the electric roaster when power is sufficiently cheap and fuel is sufficiently dear.

In this paper I have purposely abstained



FIGS. 17 AND 18.—FAURE FURNACE.

from dealing with electrolytic processes, such as that of Héroult for aluminum and of Castner for sodium, because these operations are not characterized by the use of the electric furnace. It is true that the bath is hot and that the heat is generated electrically, but the process *qua* process depends on the electrolysis of the bath, and the fact that the bath is electrically heated is merely incidental. It follows that the principles necessary to be observed for successful working differ widely from those which claim attention in the electric furnace used in its proper and limited sense. In addition to the reasonable objection which can be based on this divergence in subject matter, there is a highly practical obstacle arising from the difficulty of properly discussing this second group of processes in the space and time available. The matter is of great importance and considerable complexity, and should be handled as a distinct subject—not relegated to the position of a mere appendix or addition to a paper on another question.

In concluding, it may be permitted to make a kind of summary which shall set out the existent or probable applications of the electric furnace to industrial needs and to the preparation of novel and useful materials. At the beginning of this paper it was stated that "the function of an electric furnace is to produce a temperature of a degree or in a place unattainable by other means." With this dictum as a guide the examples cited above range themselves in an orderly, coherent scheme. It will be found that other cases which may arise can be classified thus, for when the substance to be prepared requires for its production a temperature above that attainable by combustion, it must be made by the electric furnace according to our present knowledge, and when it has to be produced at a fairly high temperature in an enclosed space, and with an exclusion of air, electrical heating, though not a necessity, commonly presents great advantages. These two conditions—the need for a high temperature and the application of internal heating—substantially determine whether a given reaction will be better performed by electrical energy or by some more familiar means of heating. These canons, when applied, give the following groups: First, products for which the electric furnace is indispensable. These are calcium carbide, carborundum—both already in large use—carbon boride, fused quartz in quantity, graphite, the diamond and the ruby, as imminent industrial possibilities. Secondly, those substances which may be prepared by other methods, but are difficult to manufacture economically by any external method of heating. Such are zinc, phosphorus and carbon disulphide. I would add steel, for to heat this most delicate material in contact with ordinary fuel and its products of combustion is to invite disaster. Siemens realized this clearly enough, and if our friends at Sheffield were a little less tied by tradition his ideas would have been in successful operation twenty years ago. These two groups provide a field of work wide enough and diversified enough to satisfy the most ardent investigator or the keenest industrialist. I have endeavored to point out where honor and profit may be sought, and I am confident that the competent seeker will reap an abundant harvest. The institution which I am addressing has already shown an appreciation of the industrial and commercial importance of electrochemistry, and to it I would respectively commend the fostering of this branch of its activities.

Electric Elevators, Electric Hoists and Telpherage—II.

Papers and Discussion at the One Hundred and Sixty-Fourth Meeting of the American Institute of Electrical Engineers—(Concluded.)

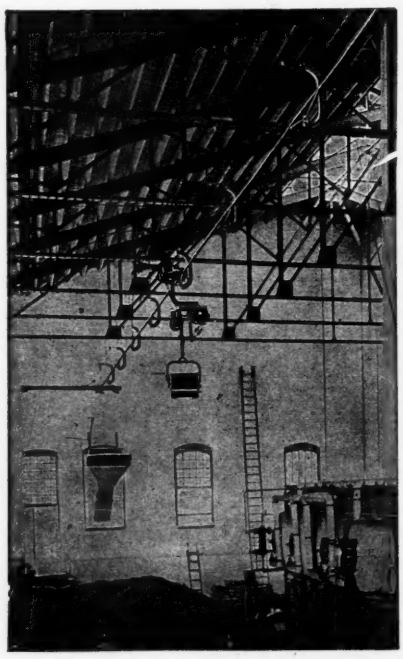
TELPHERS—According to the construction, telphers are divided into two distinct classes, centre bearing and side bearing. The centre bearing has two motors, one on each side of the track, while the side bearing has both motors on the same side. Illustrations of each kind (Figs. 8, 9, 10, 11 and 12) are shown, also the same in operation. All the weight in the side-bearing telpher is utilized for traction, and the load is suspended beneath the driving wheels. Sometimes two telphers are connected up together in a single truck, this giving what is called a double telpher, or a trailing wheel is used after a double telpher in order to distribute the weight over a greater portion of the track. This is necessary when the weight of the load to be carried is great.

FIG. 6.
Solid rail combined with cable construction. Capacity, 150,000 lbs. of ashes in ten hours. At present, handling the ash output of 23 boilers with other refuse. Average power consumed about one horse-power. Located in New York city.

Fig. 13 shows quite fully this weight distribution. In all telpherage work, gears are rarely used except for very heavy work or on steep grades. The frames of the later telphers are made in one casting, and the driving wheels are of steel, this having been determined to be the best material.

Motors—The motors are water-proof and dustproof and are compound wound for automatic work. When a telpherman goes with the telpher the series winding is employed. There is also used a special series coil to give greater torque when starting. The telpher is placed above the track, thereby keeping the motors from injury, while there is also no danger of their coming in contact with the carriers or being otherwise injured.

Hoists—The hoist is suspended below the telpher or sometimes from a trailer drawn by the telpher. Special attention has been paid in the later designs of hoists to use as little head room as possible. It was deemed best at first to combine the telpher and hoist all in one, but there were so many cases where it was necessary to use the telpher alone without the hoist, and also where it was advisable to put the hoist on the trailer instead of on the telpher, that experience has shown it is better to make the telpher and hoist two separate pieces of apparatus. Greater simplicity has also been obtained, and a correspondingly lower maintenance reached. There are many other interesting details concerning hoists, as to the speed, lift and construction, which it is necessary to omit here.



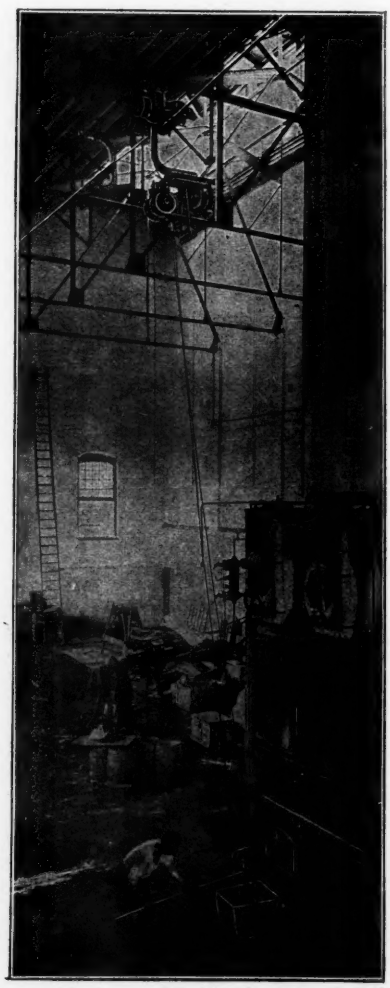


FIG. 7.
Examples of cable construction with telpher, electric hoist and bucket, Elizabethport, N. J.

Brakes—Two distinct types of brakes are used on telphers, either hand brakes or solenoid brakes, both of which are arranged to apply pressure to the wheels or to grip the track. In regard to the solenoid brake, it is only necessary to explain that it works automatically, the solenoid being placed in series with the armature. A spring normally holds the brake on the wheel or the track. If, however, from any cause, the amount of current passing through the solenoid is reduced, whether

by means of external resistance or by reason of the additional counter electromotive force generated by the armature, due to running at a high speed, the solenoid becomes weakened and the brake is applied. An air cushion is arranged so that the brakes will be applied gradually.

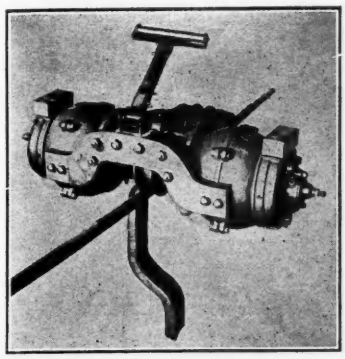


FIG. 8.—CENTRE-BEARING TELPHER.

Trailers—It is often advisable where a large amount of material is to be carried, especially over one track, to use trailers. These consist generally of a two-wheeled truck, below which is suspended a bucket or other suitable form of carrier, or even the hoist, as the case may require. It is customary where a large amount of material is to be carried to arrange a long train carrying as much as ten tons. The order of procession is, first, a telpher with four or five trailers, then another telpher and four or five trailers, and a telpher at each end. The placing of these telphers at intervals greatly adds to the traction, while the distribution of weight over the

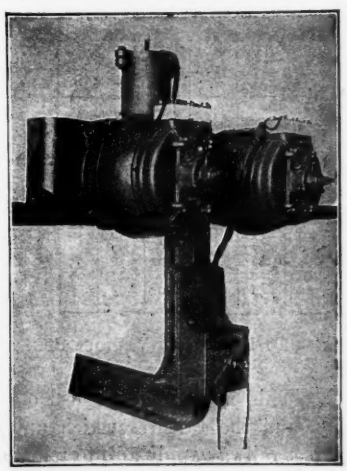


FIG. 9.—TELPHER WITH SOLENOID SPEED REGULATOR FOR GRADES AND REVERSING SWITCH.

whole span, or over two or three spans, enables much lighter construction to be used for greater capacity.

Layouts—Much engineering skill is required to lay out or plan the telpher lines for any proposed work in order to decide whether the line should be single or double, and the weight to be carried by each unit. The installations should be so planned that the expense will be reduced to a minimum, and further, that the track will not interfere with existing machinery or buildings, taking care to avoid an excessive number of curves and switches, as these add more or less to the expense, particularly to the cost of erection. It is necessary, therefore, for the selling engineer to be thoroughly trained in this part of the work, or else have the necessary engineering knowledge derived from some other similar business. It can readily be understood that it is impossible to give general prices for telpherage work. There are, therefore, provided complete specification blanks, with many necessary questions, and the replies to these questions, together with a blue-print showing a plan and elevation, is generally sufficient for the company to give a complete estimate for any proposed installation.

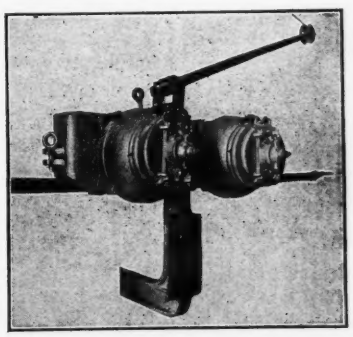


FIG. 10.—FRONT VIEW, SIDE-BEARING, SINGLE TROLLEY.

It is difficult to treat in a general way of the method of operation.

Method of Operation—In automatic lines it is necessary to provide appliances whereby it is impossible for an unskilled operator to injure the telpher. In order, therefore, to provide for contingencies, a "dead section" is placed at each end of the line, the middle of the line being generally left alive. Upon closing a spring switch, the dead section is energized so long as the operator keeps his hand on the switch, which is generally only a few seconds, during which time the telpher passes to that portion of the line which is always alive. When it reaches the other end it comes upon the dead section and then either slows down of its own accord, or else a mechanical or solenoid brake is applied. The telpher then passes under the reversing arrangement and it is therefore reversed, either with no current in the line or else with a high resistance. If the telpher is at the further end of the line, the operator at the near end, by closing a switch, can bring it back to him. The dead sections at the end of the line, which only have current so long as the hand is held upon the spring switch, render the line as safe as possible against the telpher coming in contact with the terminal posts. An automatic block system prevents collisions of telphers.

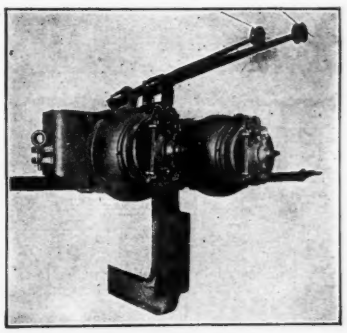


FIG. 11.—SIDE-BEARING, DOUBLE TROLLEY.

Curves—The curves are solid rail and likewise the trolley track where there is a curve, especially when same has a short radius. Wherever it is necessary to pass around a curve, take turnouts or crossovers, a resistance is inserted in the trolley circuit whereby the telpher automatically reduces its speed while it is traversing the curve or turnout, or approaching a crossover switch. As soon as it reaches the other side of the curve it receives full voltage and continues at its normal speed. In regular service the speed varies from 300 or 800 feet per minute up to twenty miles per hour, or even more, when required. The slower

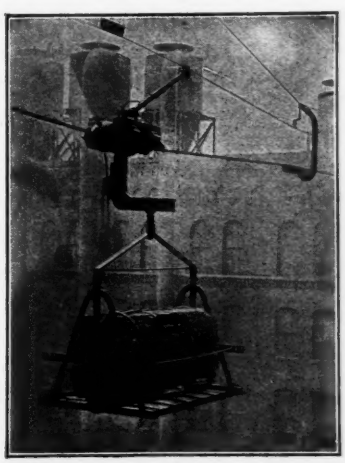


FIG. 12.—SIDE-BEARING TELPHER, SHOWING METHOD OF SUSPENSION.

speeds are used when the lines are short and where there are many curves, particularly for factory and foundry work. For lines running across the country a speed in excess of twenty miles per hour can be obtained, but with the higher speeds the cost of the construction increases, certain

special devices being necessary. Even for installations which are termed "cross-country work," fifteen to twenty miles per hour has been found amply sufficient.

As to what the ultimate capacity on grades may be, this has not been fully determined. Experimentally not more than twenty per cent has been reached as yet. In actual practice the greatest grade equipped is twelve per cent, and thus far there seems to be ample traction.

Although the amount of power can be easily figured out, yet it is somewhat in the nature of a surprise when we consider that to carry half a ton on a level track, at a speed of six miles per hour, much less than a horse-power is required, including all losses. This is a revelation to most manufacturers. The absence of gearing, the motors being attached directly to the driving-wheels, gives the highest efficiency possible, as well as freedom from noise.

The actual power consumed, according to the table given above, at six miles per hour for 1,000 pounds on a level is only 0.16 horse-power. It is therefore seen that simple allowance is made for losses and extra weights not provided for in the load, such as down-comes, buckets or carriers. The power required increases greatly with the grades, and when this reaches certain limits it is deemed advisable to use gears in order to reduce weight of motors.

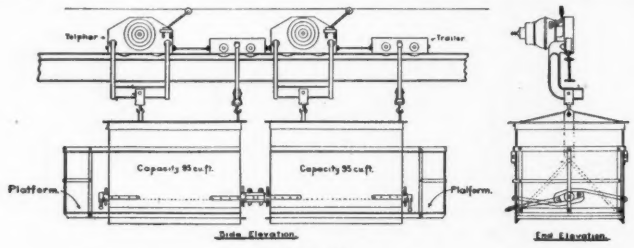


FIG. 13.

The double telpher; maximum traction; capacity, four tons of coal or 95 cubic feet; speed, 800 to 1,200 feet per minute. Side-dumping bucket operated by telpherman; controlled from either end. Telphers can be operated separately.

Three of these double telphers have a capacity of 250 tons of coal per hour over 2,000 feet of track. Labor, power and maintenance less than one cent per ton.

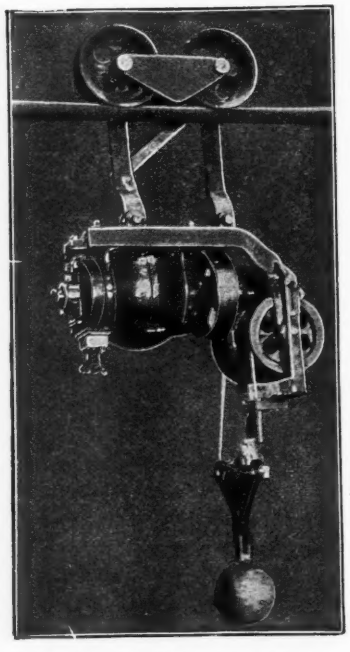


FIG. 15.—ELECTRIC HOIST AND TRAILER.

Maintenance — Although telpherage has not yet been in operation for a sufficient number of years to determine exactly what the maintenance would be, yet, at the same time, in lines that have been operated for a year and a half, the maintenance has been exceedingly small. As stated above, the driving-wheels being of steel, none of them has thus far shown any signs of wear, and trailer-wheels are of the same material and type which have been used on mechanical cable lines for ten years and are still in good serviceable condition. The motors, on account of their elevated position, have shown a better maintenance than stationary motors of the same type. This may possibly be from the extra care taken in their construction. In regard to the track, this has also shown most excellent results, also due to the fact that it is above grit and dirt and crossing teams, and, when well painted, has shown little signs of wear or depreciation. Wherever a change is made from cable to solid rail, or where cable passes over hangers or brackets it is protected by what are called "shields," these being arranged so that they can readily be replaced. The cable is also protected at the hanger and brackets by steel shields.

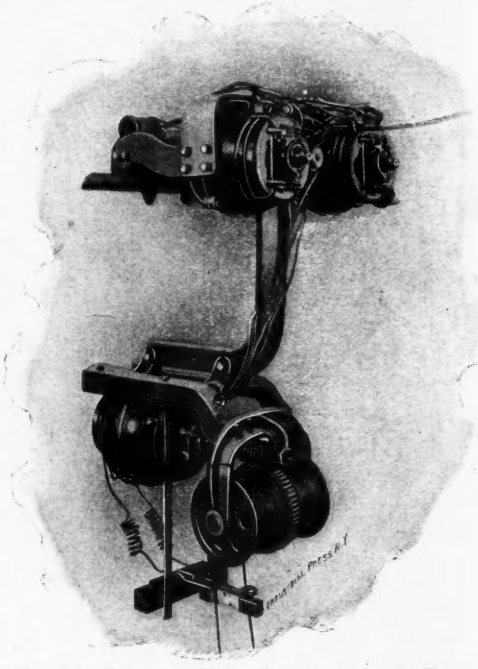


FIG. 14.—ELECTRIC HOIST SUSPENDED FROM TELPHER.

Capacity—An important feature in telpherage is the capacity of the line. In general I can say that there is no form of conveyor known which shows such a flexibility. This is due to the use of electricity, and the features which apply to the street railway apply also to telpherage. There are two factors of special importance in relation to the capacity of the line: First, the speed, and second, the number of telphers and trailers. The line can be laid out with one telpher and a few trailers. More telphers on trailers may be added, and, if upon a single line, coupled in long trains. If it is still further desired to increase the capacity, the

Grades in per cent.	SPEED IN MILES PER HOUR.													
	1	2	3	4	5	6	7	8	9	10	12	15	20	25
0	.027	.053	.080	.107	.133	.160	.187	.213	.240	.267	.320	.400	.533	.667
1	.053	.107	.160	.213	.267	.320	.373	.427	.480	.533	.640	.800	1.07	1.33
2	.080	.160	.240	.320	.400	.480	.560	.640	.720	.800	.960	1.20	1.60	2.00
3	.106	.213	.320	.427	.533	.640	.747	.853	.960	1.07	1.28	1.60	2.13	2.67
4	.133	.267	.400	.533	.667	.800	.933	1.07	1.20	1.33	1.60	2.00	2.67	3.33
5	.160	.320	.480	.640	.800	.960	1.12	1.28	1.44	1.60	1.92	2.40	3.20	4.00
6	.186	.373	.560	.747	.933	1.12	1.30	1.49	1.68	1.87	2.24	2.80	3.73	4.67
7	.215	.427	.640	.853	1.07	1.28	1.40	1.71	1.92	2.14	2.56	3.20	4.27	5.33
8	.241	.480	.720	.960	1.20	1.44	2.68	1.92	2.16	2.40	2.88	3.60	4.80	6.00
9	.267	.533	.800	1.07	1.33	1.60	1.87	2.13	2.40	2.67	3.20	4.00	5.33	6.67
10	.293	.586	.880	1.17	1.47	1.76	2.05	2.34	2.64	3.03	3.52	4.40	5.36	7.33
11	.320	.640	.960	1.28	1.60	1.92	2.24	2.55	2.88	3.20	3.84	4.80	6.40	8.00
12	.346	.693	1.040	1.38	1.73	2.08	2.43	2.77	3.12	3.46	4.16	5.20	6.93	8.67

THEORETICAL HORSE-POWER NECESSARY TO PROPEL 1,000 POUNDS AT VARIOUS SPEEDS AND UP VARIOUS GRADES AT SAME SPEEDS.

line can be made double, while, if desired, the carriers may also be made continuous so as to take boxes and barrels or other material as fast as it can be delivered to the carriers of the telphers and trailers.

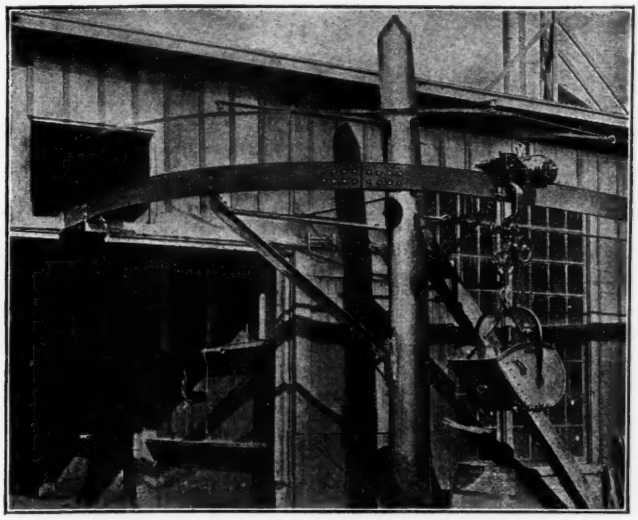


FIG. 16.

Telpher with automatic dumping bucket traversing a curve. This shows a telpherage plant located at Buffalo, N. Y. This installation is interesting on account of its automatic features. The bucket is loaded at the cars and the load is transported by electricity to the end of the line, where the bucket automatically dumps its load. The telpher reverses itself and returns with the empty bucket to the cars for another load. The telpher can be operated by unskilled labor with the minimum of expense for power, maintenance and first cost. Power less than one horse. The material which is dumped into a hopper is then elevated to the upper story. This line consists of a straight section and a right-angle curve. A portion is cable, and the curve and the track in the building are solid rail. The line is supported, as will be observed from the photographs, from ordinary telegraph poles, and is an excellent example of simple construction.

The flexibility of telpherage in regard to capacity is wonderful, and is a most important feature. In fact, it may be said that there is practically no limit to flexibility. In one plant, about to be installed, the proposed capacity is 250 tons per hour, over a distance of one-half a mile, the material to be distributed over an area of about an acre. Any one who is familiar with conveying will note that there is no other system that can do this so economically, cheaply, and, in a way, so thoroughly satisfactory a manner as telpherage.

The nature of installation varies with the amount of material to be carried, so that if the amount to be carried is small, the expenditure need not be great.

Figs. 17, 18 and 19 show various applications.

Applications of Telpherage—There are few factories where the installation of an overhead telpherage system would not prove a valuable investment. The question is often asked: Is telpherage suited for carrying specific articles? And the reply may be that it is adapted to the conveying of the products of almost every kind of manufacturing.

In these days of consolidation of companies, factories cover immense areas. The individual buildings are frequently large enough in themselves to utilize a telpher line. In many cases, on account of fire risks or of convenience in manufacturing, the buildings are widely separated from each other, and yet constant communication is necessary. Overhead telpherage, therefore, in manufacturing establishments is used for carrying the raw material, implements and finished products from one part of the grounds to another, from one building to another, or even from one part of a building to another part, moving raw material from cars or vessels to the works and then taking the finished products to the railway station, or the wharf, for shipment; for conveying refuse away from the factory. In this connection we might mention the conveying of ashes or slag to the dump heap.

Telpherage can also be extensively used for handling coal. It serves to greatly reduce the cost of transportation on plantations and farms and can be economically used for handling coffee, sugar-cane, tobacco, fruits and hay and other like products.

In general, it may be said that wherever material is to be carried to a distance, there is no power so flexible, so economical in first cost of installation, costing so little for power or the expense of maintenance, and with such great capacity, as telpherage. It may, therefore, be designated a material transportation by an immaterial fluid, and may well be called one of the most important of the many adaptations of electricity.

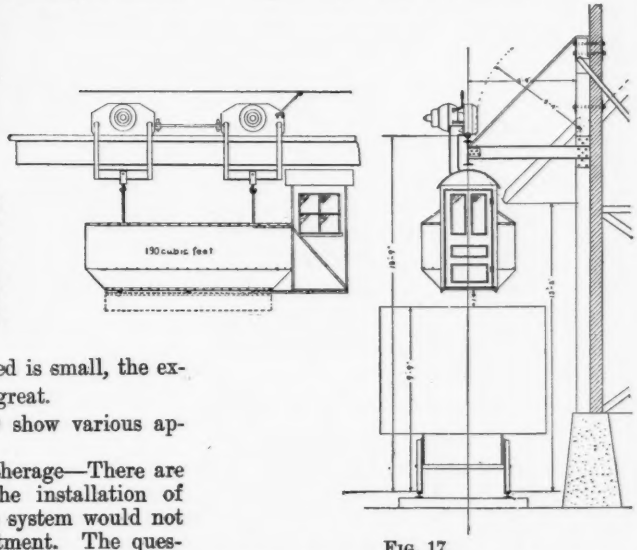


FIG. 17.

Plan and elevation of another form of double telpher with four-ton coal bucket, bottom dumping, cab for telpherman. The side elevation shows method of attachment to side of building and loading chute.

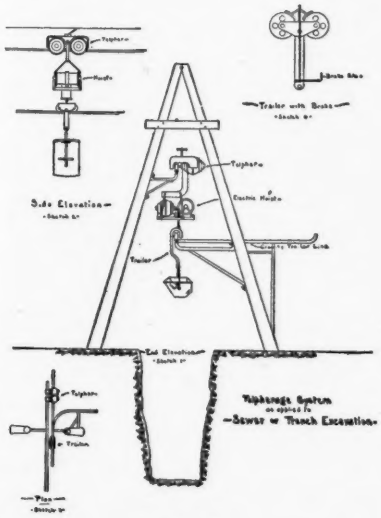


FIG. 18.

In sewer or trench excavation the method of operation is as follows: The bucket has attached to it a trailer wheel. The bucket and wheel are lowered into the excavation, and the bucket when filled is raised by the electric hoist so that the wheel of the trailer engages the gravity rail. The load then passes by gravity to the place desired and is automatically dumped. This may be along the line of excavation, for refilling the trench, or to the right or left for unloading into carts, or in connection with the telpher to any desired distance. The telpher has the flexibility of a trolley car. This method is a combination of telpher and gravity lines, and the amount of work that can be accomplished by it with the minimum of labor is remarkable.

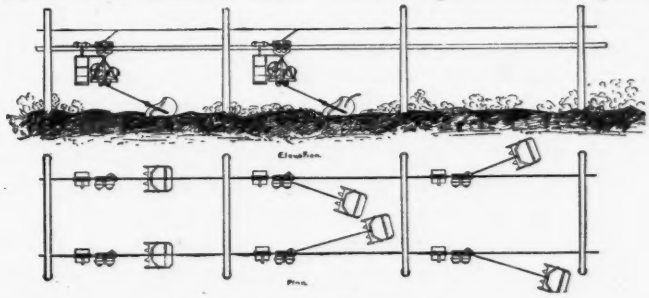
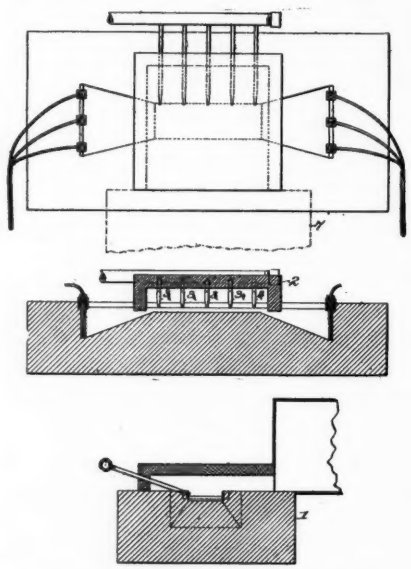


FIG. 19.

Excavating and leveling in preparing road-beds for railroads. The function of the telpher is to transport the hoist, bucket and load. The hoist does the excavating and elevating. The hoist automatically brakes itself either upon the girder rail or grips the cable as soon as there is any longitudinal strain. Used also for scooping and transporting earth, sand, ashes or coal.

Electrical Patents

Mr. Clarence S. Lomax, of Everett, Mass., has a new electrical method of making oxide of tin and lead. The invention contemplates the manufacture of the oxide of tin and lead by simultaneously subjecting the metal to the action of an electric current of sufficient quantity to heat the metal to the proper temperature and to the action of an oxidizing reagent, such as air, so that the heated metal will be oxidized by the oxidizing reagent. According to the preferred method of carrying out the invention the process is carried on continuously, the metal being heated by the continuous passage therethrough of the electric current and the oxidizing reagent being continuously applied to the metal so heated. A suitable hearth or receptacle for the metal is employed, which is made of electrically non-conductive refractory material provided with circuit terminals at its ends, by means of which the current may be caused to pass through the metal and to heat the same to a temperature suitable for the application thereto of the oxidizing reagent in order to secure the rapid oxidation of the metal. For this purpose the hearth or receptacle for the metal is constructed so that large contact surfaces may be provided for contact with the terminals of the electric circuit in order that such terminals may be kept cool and not be injured by the action of the current or by the heat generated by the current in passing therethrough, with the consequent adulteration of the tin or lead contained therein. To the above end the hearth or receptacle has enlarged ends, which receive large terminal plates of copper attached to the terminals of the circuit, and gradually to taper the cross-section of the receptacle, so that the portion of the metal which is exposed to the action of the oxidizing reagent shall be the smallest and uniform in cross-sectional area, being thereby heated to the highest temperature. This form of hearth or receptacle is employed because it enables the localization of the heating of the metal contained therein at the place where the oxidizing reagent is applied. It is also to be observed in this connection that the cross-sectional area of the metal at the middle of the hearth or receptacle can be varied by increasing or diminishing the quantity of metal in the hearth or receptacle so as to vary the resistance thereof, and thereby regulate the heat generated by a given current and the temperature of the portion of the metal subjected to the action of the oxidizing reagent. In this manner the product can be varied. The size of the circuit terminals should be proportioned to the amount of current which is intended to be used, so that the terminals will not be unduly heated by the passage of the current at the point where they come in contact with the liquid metal in the receptacle. In order to maintain the level of the molten tin or lead at a constant height, a bar of tin or lead is gradually introduced into one end of the hearth or receptacle. The surface of the molten metal in the hearth or receptacle is exposed to the action of an oxidizing reagent which, by combining with the metal, forms its oxides and is carried off in a fine powder. The chemical action is combustion, the heated metal burning in the atmosphere of the oxidizing reagent. Atmospheric air is used as the oxidizing reagent, although any other suitable reagent may be employed. The oxidizing reagent is applied only to the central or hottest portion of the metal, so that the metal subjected thereto is maintained at a substantially uniform temperature, which would not be the case if the whole surface were exposed. For this purpose there is employed in connection with the hearth or receptacle an oxidizing chamber of electrically non-conductive refractory material which is extended over the central portion of the hearth or receptacle, being the portion thereof which is smallest and uniform in cross-sectional area. This construction, in which the metal in the oxidizing chambers is uniform in cross-section, secures uniformity of temperature of the metal exposed to the oxidizing reagent. The oxidizing reagent may be introduced into the oxidizing chamber in any manner, as by twyers, which are extended through one of the side walls of the oxidizing chamber into the same and which preferably discharge the oxidizing reagent upon the surface of the molten metal.

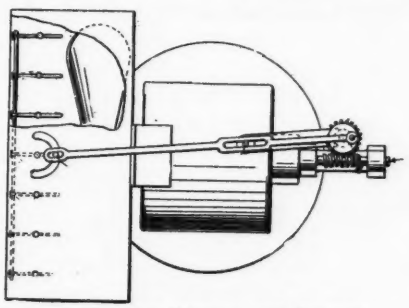


APPARATUS FOR MAKING OXIDES OF TIN AND LEAD.

Two Germans, Herrn. Johannes Stocker and Hermann Zander, of Berlin, have just patented in this country a new insulating substance, and the process of making the same, which substance is an excellent insulating material against electricity and heat; also serves for steam-joints, and is also fire, water and acid resisting. It possesses the property of being capable of being worked, bored, cut, nailed, polished and the like, worked on a lathe, and of having threads cut thereon. Plates, tubes, bars and other moulded articles of suitable length, width and thickness may also be made therefrom. The substance may be suitably colored, patterned, provided with suitable recesses and elevations and the like, so that imitations of marble, granite, slate and the like may be made therefrom which may be employed more particularly for covering walls; also imitation slates for roofing purposes, which latter have the advantages over natural slates of being unbreakable, cheaper, lighter weight, and capable of having tongues and grooves formed on the plates, and thus being fitted closely to one another to a completely even surface, while the joints can be filled up with the same substance in a liquid condition, so that when the same is set a uniform or unbroken plate, roof or wall is obtained. The manufacture of this substance takes place as follows: Three parts of caustic potash are dissolved in twenty parts of water, and a one-fourth part of borax is dissolved in the mixture, and then as much finely ground lardite (lardstone) is added thereto until a thick liquid paste is formed, which is kept for about twenty-four hours in a hermetically closed vessel. The addition of borax has for its object to effect the complete solution of the lardite when dissolved with caustic potash, which could not be fully obtained with borax. By allowing the mixture to stand for twenty-four hours with air excluded the borax allies itself completely with the greasy constituents of the lardite, and by this means a fully homogeneous lardite paste is obtained, which is an indispensable condition for obtaining a perfectly impervious final product. After the superfluous liquid has been removed from the lardite paste thus obtained, two parts of calcined alum (preferably the commercially sold and

so-called "feather-alum" or striated alum, a fibrous or wadding-like alum, which can be completely dissolved) are added thereto, and also, according to the desired hardness of the finished product, one to three parts of calcined magnesia, which is finally stirred with a small quantity of chloride of calcium and three parts of some greasy material. The object of the addition of chloride of calcium is to reduce to a small amount any moisture still existing in the mixture and to protect the final product against the reabsorption of moisture and to render it permanently non-absorbent. The chloride of calcium may be dissolved in milk before being added to the mass in order to bring into action in the ordinary manner the casein contained in the said milk; but this is not absolutely necessary. Any suitable grease substance may be added, the object of this addition being to render the substance unattackable by acids and other like destructive substances. Oil would at first suggest itself as being the easiest to evenly mix with the substance; but oil easily again runs out of the mixture when the latter is hot-pressed, and therefore a somewhat large quantity of oil has to be employed. The manufacture has been found more economical when a grease of higher melting-point is employed—such, for instance, as Brazilian wax, which has a very high melting-point and is therefore preferable, as a considerable saving of grease is effected by its use. Brazilian wax is rubbed down before its addition to the mass in order to allow of its being evenly incorporated therewith. By suitably coloring the above-described compound the final product may be made in any desired shade of color. Where the compound is to be mixed with color it is first ground in a color mill, the mass run into moulds, subjected therein to a somewhat considerable heating, dried for two to three hours in a drying stove until it contains very little moisture, and then finally compressed under an hydraulic press heated by steam, the said steam having a temperature of 100 degrees to 150 degrees. Before this treatment the still fluid mass may, if desired, have layers of papers, canvas or the like inserted, which serves as a filling material and reduces the cost of the product owing to the cheapness of the paper. The paper or the like is soaked with the mass, then the layers laid over each other, and then hotly pressed. This is a special modification of the manufacture. If articles are to be made of the substance itself without such insertion—for instance, for insulation purposes—the as yet unshaped or unmoulded but still thoroughly dry mass is preferably reduced to a fine powder and suitable moulds are filled therewith in which the pulverulent mass is converted into a solid perfectly homogeneous form by heat and pressure. In this manner the most thorough mutual adhesion of all the particles is brought about in such a way that all porosity in the final product is avoided and it is capable of being used for insulation.

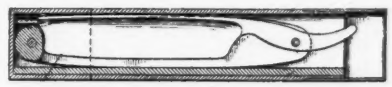
Considerable activity is being shown in providing means for directing the current of air from an electric fan to different parts of the room, and a most ingenious device is that devised by Mr. Walter E. Coleman, of New Dorp, N. Y. In this new arrangement a rectangular casing is secured about the fan, and in the front of the same are placed a series of



An Improved Method for Driving Electric Fans.

deflector plates arranged to move simultaneously like the leaves of a blind or shutter. The fan shaft is projected rearwardly of the motor casing, and means connect this shaft with the deflectors for oscillating them to direct the current of air in different directions. In one instance this means is in the form of a pivoted lever, the front end of which is connected with the shutters or deflectors, the rear end having an eccentric connection with an upright shaft, the lower end of the shaft being provided with a worm-wheel that meshes with a worm upon the fan shaft. In another form the inventor employs an endless belt traveling over suitable pulleys, the deflectors being also provided with pulleys so that they are completely rotated.

Mr. Oscar Newhouse, of San Francisco, Cal., has discovered a method of keeping the edges of cutting instruments sharp without the necessity of any manual labor. Mr. Newhouse thinks so well of his discovery that he has obtained a patent upon the same. The invention is especially useful in fine instruments having a keen edge, such as razors and the like, which edges, as is well known, have minute teeth or projections that cause the "drag" and "pulling" when shaving. The inventor claims that by placing the cutting edge of the blade in proximity to a magnet and retaining it in that position for a considerable period of time, these teeth or projections will be drawn out by magnetic force so that the edge will be comparatively even and much sharper. The manner of using the invention will be apparent by reference to the accompanying



A Magnetic Razor Sharpener.

drawing, which shows a razor placed within its usual box or casing, a bar magnet being arranged within one side of this casing and contiguous to the edge of the razor. After shaving it is only necessary to place the razor away, as shown, and the magnet will be operating upon the edge so that it will be resharpened by the time it is ready for use again. The inventor affirms that he has carefully tested the arrangement and has found that the razor can be used a great many times without stropping or honing it.

Electricity in Textile Establishments.

At the spring meeting of the New England Cotton Manufacturers' Association, held in Boston, April 23 and 24, a medal was presented to Mr. Sidney B. Paine by Mr. Alfred E. Adams, on behalf of the board of government of the association. The resolutions stated that the board of government awarded the medal for Mr. Paine's paper on "The Electrical Driving of Textile Establishments" contained in volume lviii of the transactions, and also because of its wish "to recognize the value of Mr. Paine's engineering skill in the practical development of the electrical transmission of power." Mr. Paine has been associated with the Edison companies and their successor, the General Electric Company, in New England territory for over twenty-one years.

Lecture on Power Distribution.

Mr. W. W. McFarland, acting vice-president of the Westinghouse Electric and Manufacturing Company, will deliver a lecture on "Electric Power Distribution in Manufacturing" at Cornell University on Friday, May 9. The several different systems of distribution and their relative advantages will be discussed and the manner of applying electric motors to machinery will be illustrated by a large collection of stereopticon views.

Electric Traction on Main Lines.

In a multitude of counselors there may in truth be wisdom, but when each individual adviser advocates a course entirely different from that recommended by his fellows, the recipient of such divergent advice may well be excused if he postpones action until there is attained a certain measure of agreement as to the best procedure. The question of applying electricity to the operation of ordinary railway lines has of late occupied much attention, and almost every other eminent electrical engineer has a plan of his own which he is convinced constitutes an effective solution of this very difficult problem. Some of them claim that this solution is to be found in the adoption of the three-phase system; Mr. Swinburne advocates a constant-current series system, and Mr. Mordey recommends a single-phase alternate-current system combined with Ward Leonard's plan of regulating speed and torque by making each locomotive a complete substation. Mr. Mordey's paper was read before the Institution of Civil Engineers on February 18 last, and on the twenty-seventh of the same month a paper was read by Mr. E. Huber before the Zurich Association of Engineers and Architects, in which he also set forth the advantages to be gained by the Ward-Leonard system, and gave some particulars as to the work already accomplished by the Maschinenfabrik Oerlikon in elaborating a complete scheme of heavy electric traction on these lines. Mr. Huber proposes to use a trolley line conveying to the locomotive an alternating current at a potential of about 15,000 volts. By means of a motor-generator on the locomotive this current is used to generate a continuous current at, say, 700 volts, which in its turn is used to drive the axle motors. By altering the excitation of the fields of these motors, and of the continuous-current generator, the speed of the locomotive can be varied in a practically continuous fashion without wasting current in external resistances, as is necessary with the series-parallel controller used for motor tramcars. Mr. Huber claims that for main-line traction locomotives must be used, the plan of using separate motor vehicles running at frequent intervals, while suitable for certain kinds of passenger traffic, being quite unfitted for handling the heavy goods traffic on which our railways earn so large a proportion of their profits. Moreover, a change to single-car trains would upset all existing time-tables, disturb the present arrangements for transfer of traffic between different main lines or between a main line and its branches, and would, in other respects, cause great inconvenience to the management. Accepting the use of a locomotive as necessary, Mr. Huber holds that these should be able to take a train of 250 tons up a gradient of 1 in 100 at a speed of twenty-five miles per hour, and to do this he estimates that 575 horse-power are necessary as measured at the drawbar. Such a locomotive is now being completed by the Oerlikon company. This locomotive is to be worked on the Ward-Leonard system, being fitted with a motor-generator taking up a single-phase alternating current at 15,000 volts, and transforming it in a continuous current at 700 volts, which will be used for driving the motors. It will be capable of working at the rate of 700 horse-power as measured at the drawbar, and will be able to exert a drawbar pull of five tons when running at a speed of twenty-five miles per hour. Its weight, in working order, is forty-four tons, made up as follows:

	Tons.
Frames, wheels and car body	15
Motor-generator and exciter	16
Regulating gear, conductors and collectors	1
Brake arrangements	1
Axle motors	11

A three-phase locomotive of equal power would weigh only about thirty tons, but Mr. Huber holds that this advantage in weight is more than offset by the difficulties arising in connection with the trolley wires of a three-phase system. At least two such wires would be required, and in spite of the results obtained on the Berlin-Zossen line, it would seem that the system is badly adapted for use on railways having, like ordinary lines, numerous branches involving complicated switches and tunnels in which the space to accommodate even a single trolley wire is barely attainable. It is, of course, admitted that a trolley wire at 15,000 volts is prohibited in most cases by government regulations, but Mr. Huber does not despair of obtaining an alteration of the law in this regard, and the construction by his company at a heavy outlay of the forty-four-ton locomotive above referred to has no doubt been undertaken with a view to providing officials with an object lesson as to the efficiency of the safeguards provided for the protection of the passengers and staff.

Assuming that 575 effective horse-power are needed to take a train weighing in all 250 tons up a gradient of 1 in 100 at twenty-five miles per hour, Mr. Huber holds that it will be quite possible to get a total electric efficiency of seventy-five per cent in the locomotive equipment. Hence, to obtain 575 horse-power at the drawbar, 565 kilowatts must be supplied to the motor-generator from the line, which with a mean tension of 14,000 volts, and a lag of ten per cent in the current, requires the strength of this current to be forty-five amperes. Such a current is by no means excessive, and can be safely carried by the ordinary eight-millimetre trolley wire as used on street railways. It is proposed to use a rail return, although as a result it becomes necessary to supply the alternating current at a low periodicity. The Oerlikon company proposes sixteen periods per second, and with this the rail will have twenty-seven times the resistance of an equivalent section of pure copper. With rails weighing each seventy-five pounds per yard, there would thus be a drop of 180 volts in a distance of twenty-five miles, assuming two trains to be taking current on this section. Such a drop is, of course, very much greater than is permitted with rail returns conveying continuous current; but with alternating currents, as in the present case, questions of electrolysis hardly arise, and Mr. Huber holds that experiments by his company show that by the adoption of negative boosters and the like little trouble of any kind is to be expected from the use of the rail return.

It is proposed to fix the generating stations seventy-five miles apart. A long distance between such stations is advantageous, as the greater the length of line operated from one station the more uniform the load on the plant, so that the machinery held in reserve may be proportionately much less than if a greater number of generating stations less widely separated were used. Taking the thirty-seven and one-half miles between one station and the midpoint, Mr. Huber assumes that the heaviest load to be expected on this section will not exceed that due to two trains at 12.5 miles from the station, two at twenty-five miles and two at 37.5 miles. Each of these trains is assumed to require 565 kilowatts. In practice the trains on such a section might be more numerous, but they would not all be simultaneously exerting their maximum power. Up to the 12.5-mile point there would be six eight-millimetre trolley wires, from this point up to twenty-five miles four such wires, and for the remaining section two. The losses in transmission are then estimated to be as follows:

Section.	Number of Wires.	Loss in Wires Kilowatts.	Loss in Rails. Kilowatts.
0 to 12 5 miles	5	81	37
12.5 to 25 miles	4	54	16
25 to 37.5 miles	2	27	4
Total		162	57

Hence the total loss in resistance of line and rails on the 37.5 miles would be 219 kilowatts or about 6.1 per cent of the energy sent into the trolley wires at the generating station. If the voltage at the twenty-five-mile point is taken at 14,000, it must be 14,825 at the generating station, and will have fallen to 13,655 volts at the 37.5-mile point. Much lower tensions than these would be uneconomical, and higher tensions, Mr. Huber states, are not desirable, since 15,000 volts is at present about the limit at which currents can be generated direct without special difficulty. Taking these voltages, the copper required, including rail bonds and an allowance of twenty per cent for station tracks, would average four tons per mile of double track.

For the safe employment of such high-tension currents an entirely new arrangement of trolley-wire suspension and current collecting has been worked out by the Oerlikon company. Probably owing to the fact that patents are pending, Mr. Huber did not explain this in much detail, but apparently the trolley wire is to be supported in every case either from the side or below, but not, as is the usual practice, from above. The under-running trolley is therefore abandoned. This would seem likely to make it difficult to arrange conveniently the necessary switches and crossings, but Mr. Huber claims that, on the contrary, it greatly facilitates their laying out and working; but in the absence of detailed drawings it is impossible to judge how far this contention is justified.

With the type of locomotive proposed, it will be quite easy to work the large stations and their sidings with continuous current generated at, say, 700 volts. This would be picked up by the locomotive, by a special collector, from a third rail. There would also be no difficulty in incorporating with the train single cars from branch lines, worked on the 700-volt continuous-current system. The motors of these cars, when thus added on to the main-line train, could be supplied with the current from the motor-generator on the main-line locomotive, and be controlled by the crew on the latter, without requiring any alteration in the electric equipment of either car or locomotive. It would, indeed, be possible to assist a train over heavy portions of the line by coupling to it a car provided with motors only, and without the motor-generator plant fitted to the locomotive proper. The motors of this car would be supplied and regulated from the main locomotive. In addition to the great facility with which speed and power can be regulated with a locomotive of the type described, another advantage should be mentioned—*viz.*, the ease with which power can be returned to the line on descending grades or in stopping at stations, or the like. There are other systems of electric traction in which it is claimed that energy can be restored to the line in similar conditions to the above, but in general it is necessary for this that the speed of the locomotive must exceed a certain limit, whereas with the Ward-Leonard arrangement energy can be returned in this way at almost any speed of running by suitably adjusting the generator and motor fields.

Mr. Huber has promised on a future occasion to read another paper on the subject, in which drawings will be exhibited, and more information given as to the details of the electrical arrangements, and to submit a complete scheme for the working of the Gothard railway on the system proposed.—*Engineering.*

An Electrical Commission Forming.

Preparations are being made for the meeting of the Electrical Commission named in an act recently passed by the legislature. The work of the commission is described as follows in an item in the Supplemental Supply Bill:

Twenty-five hundred dollars, or so much thereof as may be necessary, is hereby appropriated for defraying the expenses of a commission, to be composed of Edward A. Bond, state engineer and surveyor; Charles P. Steinmetz and Harold Winthrop Buck, hereby appointed for investigating as to the necessity for the establishment of a state electrical laboratory to provide independent, authoritative information on questions of electrical science, and an official standardizing laboratory for electrical measuring instruments, apparatus and standards for the protection of municipalities and the general public in the use of electrical energy and of the producers of electrical energy. Said commission is hereby directed to report to the legislature at the opening of the session of 1903, and if, in their judgment, the establishment of said electrical laboratory is necessary, to prepare and submit in connection with their report, detailed plans and specifications for the construction and equipment of such laboratory accompanying said plans with a specific and detailed statement of the cost thereof.

The ELECTRICAL REVIEW, of New York, has brought out a magnificent "Twentieth Anniversary" number. It reproduces some sketches of a dynamo-room in the year 1882. The machinery looks hardly more old-fashioned than the workmen and visitors.—*Invention, London.*

WIRELESS TELEGRAPHY INVENTION.

A CAUSTIC SUMMARY BY PROFESSOR SYLVANUS P. THOMPSON IN THE LONDON "SATURDAY REVIEW."

Although Signor Marconi is not the inventor, but the skilled exploiter, of telegraphy without wires, every one must admire the splendid success of his achievement in sending intelligible signals over 1,500 miles across the Atlantic. Of ultimate success in establishing regular wireless communication between the two continents there can be no question. The original inventor of the wireless telegraph, Professor Oliver Lodge, had supposed its limits of operation to be a few hundred yards. Signor Marconi two years later gave us reason to think that the range might be extended to a few miles. He pushed his methods until he attained distances of twenty, thirty, even ninety miles. Suddenly he astonishes us with messages to Newfoundland consisting of but a single repeated letter, and lastly he receives from England intelligible records upon a ship that is nearing the American coast.

To the uninitiated this sudden extension of range seemed so remarkable that the news from Newfoundland was received with much incredulity. Those, however, were not taken by surprise who knew Signor Marconi and were aware of the extensive preparations made at the station at Poldhu, of the powerful engine employed to drive the alternator, of the array of twenty masts over 200 feet high erected to constitute a transmitting battery for the electric waves. The success was the outcome of a determined plan of campaign. This brilliant result marks, however, a change in the instrumental methods adopted by Signor Marconi. It may be worth while to attempt in untechnical language to explain wherein the difference lies. The two methods may be distinguished by the names of their respective originators as the method of Lodge and the variety due to Tesla.

In the method of Lodge, the Hertzian waves (or electric waves) generated by a snapping spark between the polished balls of a so-called "oscillator" are received at the distant station upon a receiving apparatus consisting of an extended arm or conductor in combination with a "coherer," a sensitive tube containing minute metal filings, by means of which a local battery is relayed on to a suitable telegraph instrument, usually a Morse sounder or recorder. The coherer is kept in its sensitive state by receiving gentle vibrations from an automatic "tapper." Every

time that a spark is caused to pass in the oscillator a flight of ethereal waves is sent out, and each such flight of waves acting through the coherer at the receiving end delivers a signal in the telegraph instrument. By careful experimenting and unstinting expenditure on instruments Signor Marconi gradually increased the range of working from the 200 yards of Lodge's earlier successes up to ninety miles and more. He elongated the extended arm or aerial conductor; he used finer powders in the coherer; he used more sensitive telegraphic receivers, and he perfected under the meaningless name of "jigger" the induction coils in prior use.

In the apparatus of Tesla torrents of high-frequency sparks are poured out from a secondary induction coil at a place in the circuit where the discharge is blown aside by a magnetic field or—as in Elihu Thomson's variant—by a blast of air. Every one of such recurring sparks starts its own wave, with effects that are cumulative and therefore capable of being detected at much greater distances. The particular disposition of machinery at Poldhu is understood to be due to Professor Fleming. The precise nature of the detecting instrument used by Signor Marconi in Newfoundland has not been made public, but in the successful communications made in mid-Atlantic a coherer relayed upon a recording telegraph instrument was employed.

When Signor Marconi came to this country five years ago, and conducted experiments under the ægis of the Post Office officials across the Bristol Channel, he was still employing the Righi "oscillator," and the method of Lodge, with a coherer to relay the signals to a telegraph instrument, and an automatic tapper. From the patent which he took out about that time—a document in which he apparently puts himself forward as the inventor of oscillator, coherer, tapper and all—it would appear that the only real point of novelty that he could embody in his claim was that of connecting one end of his coherer to the earth while the other was connected to an elevated and insulated conductor. All else is simply detail or surplusage. It is a very thin claim and has this inherently weak point, that it is quite easy to make a coherer work in some other way—as in fact Lodge did at an earlier and Professor Slaby at a later date. The man, however, who in 1897 wants to get valid patents must avoid actually claiming the things made public in England in 1894. So it was probably wise of Signor Marconi to avoid making any broad claims to the coherer, the automatic tapper, or any of the features of wireless telegraphy already invented by Lodge. He does not claim them, though audaciously describing them as novelties. Nor do Professor Slaby and Count Arco make any such broad claims in the system of wireless telegraphs which they have independently perfected, and which has been adopted in the German Navy. Both Signor Marconi and Professor Slaby must be content to patent details only—each his own—since neither of them can put himself in the position where Oliver Lodge stands as the original inventor.

Now comes the amusing turn of the whole business. Flushed with his transatlantic success, Signor Marconi, though he has never once dared to contradict the prior claims of Professor Lodge, sends, through some of his underlings, communications to the news agencies whining about the doings of Professor Slaby and Count Arco. His grumbles are duly cabled over from New York and find credence in the English press. But the Slaby-Arco system is as much a lineal descendant of Lodge's earlier work as is Signor Marconi's. Both of them employ Lodge's methods, in that both of them use a coherer to relay Hertzian waves upon a telegraphic receiver, and both of them employ an automatic tapper. Eliminate these features, due to Lodge, of coherer-relay and tapper, and both Marconi and Slaby collapse. So Marconi, who uses—without acknowledgment—these devices of Lodge, mouths out denunciations of Slaby, who dares to use the same devices for the same purposes! It is a pretty quarrel. If Signor Marconi imagines that his thin patent claims entitle him to a monopoly of the ether for the purpose of transmitting signals he is much mistaken. His dog-in-the-manger policy toward Professor Slaby is simply silly, and the more so because neither of them can either transmit or receive a signal "wireless" message in the United States without infringing the patents of Professor Oliver Lodge. It seems like the irony of fate that Professor Lodge, the well-known principal of the University of Birmingham, after expounding the principles of wireless telegraphy in London and at Oxford in 1894 should find himself pushed aside, first by the Italian, who by dint of advertisement gains the public ear, and then by the German professor, and yet should actually stand master of the transatlantic situation because he holds the master patents in the United States. It is said that Lloyds has made an agreement with Signor Marconi for fourteen years. Perhaps Lloyds was not aware of the question as to where the patent rights lie. Signor Marconi may whine as he pleases about other men snatching the rewards from a scientific investigator; that is precisely what he himself has been trying to do for these last four or five years, his victim being an Englishman who was first in the field, and who, if he but knew it, is today master of the situation.

A Wireless Telegraph International Conference.

[*From the New York Sun.*]

An international conference upon wireless telegraphy, apparently now almost provided for, is a novelty required by the advance of science, and is stimulated, perhaps, by such commercial developments as the trustification of the steamship lines plying between Europe and America.

One government at war with another can seize the end of a cable and censor all messages over it, but with the wireless telegraph some fellow in the backwoods might send out news beyond the reach of official control. Some new arrangements between nations may be desirable.

Then, again, the Marconi company may establish its patents in America, while the Slaby-Arco company prevails in Germany. How shall wireless communication be effected at all under those circumstances, except through special international adjustment? We note in *Electricity* that Rear-Admiral Bradford, under whose supervision the wireless telegraph is being experimented with in the Navy Department, thinks that "none of the wireless telegraph companies has patent rights which are legally binding." If that is so the multiplication of wireless telegraph companies may greatly increase the need of some international understanding. . . .

Railway Telegraph Superintendents.

The twenty-first meeting of the Association of Railway Telegraph Superintendents will be held at Chicago, June 18, 19 and 20. Arrangements have been made for holding the meeting and the accommodation of members at the Stratford Hotel (formerly the Leyland), corner Michigan and Jackson boulevards. In addition to providing a convention hall, a room has also been set aside for exhibits. It is expected that the attendance will be quite large. Members are invited to correspond direct with the manager of the hotel, Mr. George B. Weaver, stating rooms they desire.

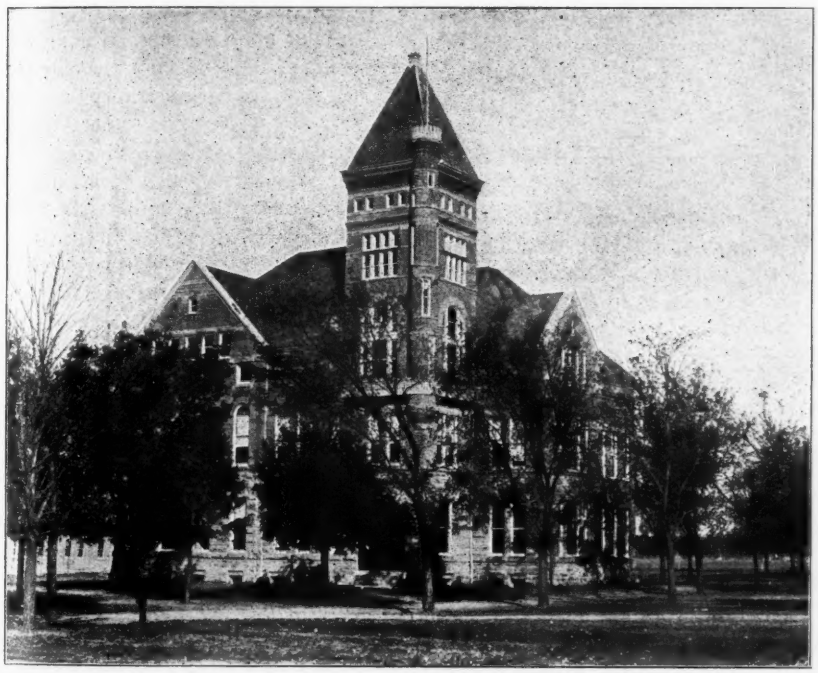
The executive committee of the association consists of Mr. C. F. Annette, president; Mr. J. H. Jacoby, vice-president, and Mr. P. W. Drew, secretary. Mr. Drew's address is Colby & Abbott Building, Milwaukee, Wis.

A University Course in Telephone Engineering.

Purdue University, at La Fayette, Ind., seems to be the first technical institution to recognize the growth and importance of the telephone field, and give the subject special department consideration. One leading telephone engineer says, "Some college men have two weeks' study of the transmitter and receiver, and master the transposition diagram," and are thus prepared to go out into telephone work.

Generally the student looks forward to dealing with heavy transmission problems, involving great units, and naturally depreciates any apparatus requiring feeble currents to operate them. He little realizes that the latter requires as much, if not more, thought and greater care. He regards the telephone instrument as the not like climbing poles. When he wants to see an exchange, he sees the legendary sign upon the door, "No admittance."

Students at Purdue University will not be confined to studies of transmitters and receivers and transposition diagrams, nor will their work be confined to theoretical and mathematical lines. These considerations will go hand in hand with practice, and each student will build circuits, will connect up relays, repeaters, retardation coils and condensers and make complete working combinations of standard subscriber sets and circuits, office trunks, toll-recording trunks and interexchange trunks. He will study considerations of balance and requirements of supervision; also the methods of operating, of handling local and long-distance traffic and make a complete study of traffic problems.



PURDUE UNIVERSITY, LA FAYETTE, INDIANA.

sole representative of the telephone science and quite beneath his notice.

The principal cause of this student apathy and distrust of the telephone business as a career has been the lack of knowledge of telephone matters by the general public, the unwillingness of the old companies to discuss features of their apparatus, even their unwillingness to let many of their employés know anything.

With the telephone business in a comparatively lock-and-key state it is no wonder that the students prefer to follow something they are more sure of. They have no chance to realize or even appreciate a fractional part of the business; all they can see is the line gang at work, and the instrument man. Naturally, one does

Several companies have donated their standard apparatus so that a student may have access to actual practice in nearly every system of prominence.

A student finishing such a course will, in a short time, become a valuable man for any telephone company, operating or manufacturing. With the advantage of starting into work equipped with the general outline of what knowledge he requires, it will be easier for him to acquire it than a young man starting in blindly. So much time is wasted by young men who work about, not knowing what they want to do. No waste of time would result if each man knew just what to do. There would be no groping about. How much better would an instrument man be if he knew the whole system? And so would every one do better. Such a state is hardly possible, each man an engineer, yet it is claimed that one big company expects eventually to have college men from president to janitor.

The design of a telephone system is founded upon just as broad principles as a power system. While no fundamental formula exists as yet, there will be some when the business grows older. Telephony is but five years old. Of course there were a few years back of 1897, but one does not like to describe those days as times of real telephone business. Then if an exchange had 2,000 subscribers it was a wonder. Now exchanges of 20,000 lines are to be common property. It is not unsafe to say that there will be 10,000,000 telephones in use very soon. It costs from $25 to $500 to build a complete subscriber's equipment. Putting the average very low, $50, this would mean $500,000,000 worth of property with a depreciation percentage of ten to fifteen per cent. To have talent enough to save even one per cent a year on this investment would mean $5,000,000; surely it is worth while trying to advance the state of telephone science.

Already Purdue University has received letters from manufacturing companies offering every graduate a position. There are more positions offered than can be filled. Some of the positions offered are very flattering to the university and the students concerned. It is safe to say that telephone engineering has earned a place in technical schools, and will fill an important place in the lives of many future great telephone men.

Mr. J. C. Kelsey is in charge of the telephone work which, although only recently organized, is one of the leading departments of the School of Electrical Engineering of the university.

Electric Railway Equipment Business Acquired.

The Westinghouse Electric and Manufacturing Company has made an agreement with the Lorain Steel Company, whereby the Westinghouse company acquires the electric railway equipment business of the Lorain company, formerly carried on under the name of the Steel Motor Company, at Johnstown, Pa. The Westinghouse company will still continue to maintain the works at Johnstown, Pa., and sell the Steel motor as an adjunct to its own electric railway business. These equipments hereafter shipped may now be supplied with the nose spring suspension, covered by the patents controlled by the Westinghouse and General companies.

ELECTRICAL MINING NOTES.

ELECTRICITY IN THE PAS DE CALAIS DISTRICT OF FRANCE.

The coal basin of the Pas de Calais comprises about 146,000 acres, and there are seventy-eight mining shafts. The inspector for the French Government, M. Fèvre, reports that 14,600,000 tons of coal were mined during the year 1900, that coal-cutting machines are being adopted with success and profit, and that electric installations are being proceeded with.

THE USE OF PORTABLE ELECTRIC MINER'S SAFETY LAMPS IN BRITISH COAL MINES.

The Sussmann lamp continues to be the only lamp in use of the portable electric type in British collieries, but it appears to be making its way slowly and surely. At Murton colliery, near Sunderland, the property of the South Hetton Coal Company, 1,000 lamps have been in use for several years, and the management expresses itself as perfectly satisfied with them. Considerable difficulty was experienced to induce the men to use them when they were first introduced, but they now would not be without them. The lamp gives from two and one-half to three times the light of the ordinary oil lamp, the Davy and its successors that are used in mines, and in addition it gives a white light by means of which coal can be distinguished from other matter, an important point in some cases. At another colliery, in the county of Durham, 300 Sussmann lamps have been in use for nearly as long as those at Murton, also with success. In Lancashire, also, at the Wigan Coal and Iron Company's collieries, 250 lamps have been in use for the past eighteen months. At the collieries in the Durham district the secondary batteries are made and repaired at the collieries so that the cost is considerably reduced, but it does not yet come down to that of the oil lamp.

AN ELECTRIC BRAKE FOR A WINDING ENGINE.

Notwithstanding the fact winding by electric motors seems so absurd to mining engineers, it is gradually making its way. In the counties of Durham and Yorkshire it often happens that what is called a "staple pit" is put down from one seam to another below it for the purpose of bringing up the coal from the lower to the higher seam, the latter being that from which it is taken to the surface. Staple pits are usually "in bye," as it is termed, some distance from the shaft and near the working face. At such a "staple pit," at a colliery in Yorkshire, Messrs. Ernest, Scott & Mountain, of Newcastle-on-Tyne, have fitted up a winding engine, consisting of a drum geared to an electric motor of the continuous-current type. The special feature of the installation is the fact that the brake is also electrical. Usually braking both for hauling and winding engines is done by means of a band encircling a portion of the winding drum, which is lagged with removable wood blocks for the purpose; and the brake is applied by a steam cylinder attached to the end of the brake strap. In the winding plant referred to above, two brakes are provided, one a mechanical foot-brake, applied by the driver in the usual manner, and the other an electromagnetically controlled brake which is applied automatically. A brake drum is fixed upon an extension of the motor-shaft, with the usual lagging, and on the periphery of this a brake strap works, which, when the motor is at rest, applies pressure to the periphery of the drum, the pressure being provided by a spring at the end of the strap. Opposing the pull of the brake spring is an electromagnet, which is in circuit with the coils of the armature of the motor. As soon as current is allowed to pass into the motor the electromagnet overcomes the pull of the spring and the drum is released. If the current ceases from any cause (and also when it is turned off in the usual way on the arrival of the cage at the top of the "staple") the spring again overpowers the electromagnet, and the brake is applied. The arrangement is very similar to the brake arrangement shown at the Glasgow Exhibition in connection with the Hoe printing apparatus of the *Glasgow Herald*. In that case a brake strap was always applied to a drum provided for the purpose, except when an opposing electromagnet overcame the pull of a spring, the coils of the magnet forming part of the motor circuit. And in case of accident, by pressing one of the pushes fixed at different parts of the machine, the current was cut off the opposing electromagnet and the spring allowed to apply the brake, the machine coming quietly to rest.

THE ORDINARY SAFETY LAMP *vs.* THE ELECTRIC LAMP IN FRANCE.

The usual struggle is going on between the oil-fed safety lamp and the electric lamp with battery attached. In France another advance has been made on the part of the oil-fed lamp which brings it nearer the electric lamp in the matter of the light given. Marsaut lamps, fed with petroleum spirit, are being used in the fiery districts of the Lens collieries, also the Dourges, Bruay and Liévin collieries. The petroleum spirit referred to is taken to mean the same spirit that is used in the petrol engines employed on motor cars. It is a later distillation of the petroleum, has a lower flashing point but a much greater calorific value for a given bulk and weight. It is stated that the lamps using the petrol spirit are locked with the Wolf magnetic lock, which is officially permitted by the French Government department.

MAGNETIC LOCKS AND ELECTRIC LIGHTING APPARATUS FOR MINERS' SAFETY LAMPS.

It is very interesting to watch the efforts of inventors to avoid going the whole hog in the matter of the use of electricity for portable miner's lamps. The progress of the use of the Sussmann, the only electric lamp on the market, is very slow, even in France and Belgium, where greater opportunity is given for new inventions to have a trial, but the aid of electricity is called in at every step to make the existing lamps more safe. Thus, in the United Kingdom, lamps are now very largely locked by means of a steel pin which slides into a recess provided for it, just as the bolt of a door does, and which can only be withdrawn by a powerful electromagnet applied below the pin, and the electromagnet is only kept in the lamp-room on the surface. Also, miners' safety oil lamps have a troublesome knack of going out if they are not very gently handled, and as it may mean death to open a lamp in some mines, in case of gas being about, it means that the lamp which is extinguished has to be sent to the surface to be relighted. Apparatus is now arranged, however, for lighting the lamp without opening it by either a spark or a hot wire, the heat in both cases being produced by an electric current from a battery of accumulators which can be placed considerably nearer to the working face of the coal than would otherwise be possible. Neither of these ideas is new, but they have recently been revived in view of the possible competition of the electric miner's lamp, and are making considerable progress commercially, one firm in South Wales having as many as 3,000 lamps fitted both with magnetic locks and electric lighting apparatus. Time is also saved when the colliers are going down the pit in the morning by the use of this arrangement. Without something of this kind all the lamps have to be lighted be-

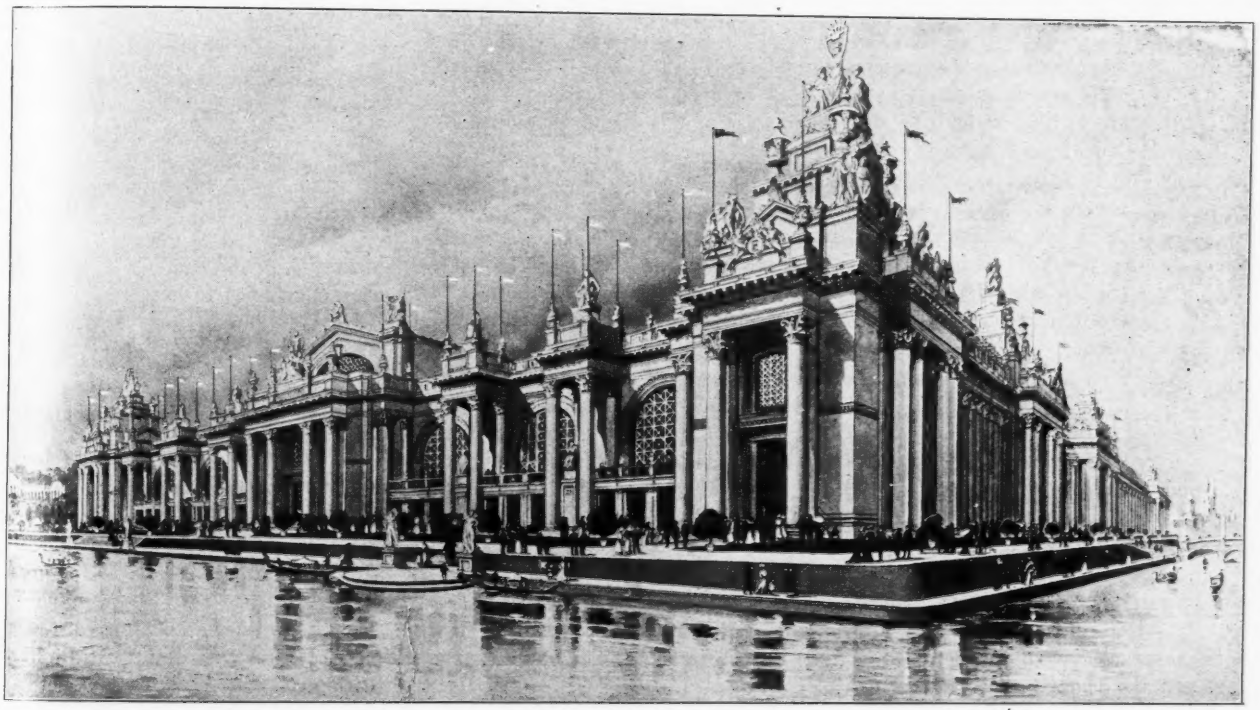
fore the first of the men arrive. With this lighting apparatus no lamps are lighted. As each man appears at the window of the lamp-room he is given his lamp, not lighted, which he places for an instant on a small table close at hand, on which are contacts in connection with a battery and induction coil, and it lights usually as quickly as he can walk by in the procession of men going to the pit-top.

ELECTRICITY *vs.* HYDRAULIC POWER FOR PUMPING IN COLLIERIES.

One of the great troubles that many mines have to face is water. If water-bearing rocks are tapped, the water runs into the mine and has to be dealt with, and it often happens that they are. M. Laponche, in *Ingeniuer des Arts et Manufactures,* has recently discussed the advantages and the reverse of electricity and hydraulics for the purpose. He concludes that where the mine has a central station for generating current, or where it is near a public supply service, electricity is the agent which affords the simplest and most economical installation so far as first cost is concerned. He thinks, however, that the efficiency is not high, that there is danger of explosion, that it is impossible to work when the apparatus is drowned, that the insulating substances deteriorate with damp; though, on the other hand, the power can be applied anywhere. He continues, when new plant has to be put down, hydraulic transmission best solves the problem of pumping from great depths, as to the advantages of electricity it adds higher efficiency, absolute safety as regards fire-damp, greater trustworthiness in working, the ability to work when the machine is under water, reduction of engine space underground to a minimum, while the slightly higher first cost is largely compensated for by the greater certainty of working.

THE STOPPAGE OF A COLLIERY OWING TO FAILURE OF ELECTRICAL SUPPLY.

There is a small colliery near St. Helens, in Lancashire, England, which is worked entirely by electricity, the current being taken from the local tramway service. Recently a supply feeder—that from which the colliery was supplied—was faulty and the supply of current was stopped for a few hours, with the result that the mine was stopped, the men underground could not come up, and no operations could be carried on.



THE ELECTRICITY BUILDING, NOW BEING CONSTRUCTED AT THE LOUISIANA PURCHASE EXPOSITION, ST. LOUIS, MO.

ELECTRICITY BUILDING.

ONE OF THE BIG EXHIBIT BUILDINGS AT THE LOUISIANA PURCHASE EXPOSITION.

The Electricity Building is now being constructed. The contract for it was awarded on March 8 to William Goldie Sons Company, the contract price being $399,940. The building was planned by Walker & Kimball, of Boston and Omaha, who were chief architects of the Omaha Exposition. The structure will be located on the main central avenue and form one of the leading elements of the main exposition picture. It will have a frontage of 650 feet toward the north and 525 feet toward the east, facing the main lagoon.

The design is a bold columnated treatment of the Corinthian order. The columns are carried well down toward the ground to give height to the façades. The façades will be well accentuated by elevated pediments and tower effects over the main entrances and at the corners. Over the accentuated places, as well as over the twin columns, which form a pleasing variation of the treatment of the façades, opportunity for ample sculptural decoration is supplied.

The fenestration is bold and appropriate, giving ample light and substantial wall treatment. On two sides of the building are to be loggias which will add pleasing effects of light and shadow. There will be numerous openings on the façades, such as exhibitors always seek in selecting their exhibit space. The plan of the building is simple and well treated, showing an effect to supply as much exhibit space as is possible with the 292,000 square feet of floor space. The exhibit space is compact and symmetrical. An extensive balcony will sweep around four sides of the building, supplying 100,000 square feet of additional space.

A tremendous traveling crane, to be used in the installation of the big electrical machinery which is to be shown in the building, will run on tracks in the western bay. Two large toilet rooms are to be located in the court of the building. The doors of the building will be of large dimensions, eleven by eighteen feet. The building will have 176 trusses, the largest span being eighty-two feet in length, 185 tons of iron and steel being used.

Reviews of Current Engineering and Scientific Literature.

Giving Concisely the Substance of Important Papers in the Scientific, Electrical and Engineering Press of the World.

Influence of Hydrogen on Iron.

Some interesting experiments have lately been carried on by Herr R. Heyn at Reichsanstalt at Charlottenburg in studying the influence of hydrogen upon iron. The gas was allowed to act upon iron at a red heat and it was found that the metal was considerably affected. Iron heated to redness and plunged in an atmosphere of hydrogen, then tempered in water, becomes very brittle and this brittleness is especially remarkable in cold-bending tests. If the iron be again heated even at a low temperature in a water bath or oil bath it regains some and occasionally all of its original properties. The same thing happens when iron is allowed to remain in the open air at a normal temperature, the time required for it to attain its normal condition varying with the constitution of the piece of iron under test.—*Electrical Engineer* (London), April 11.

The Transmission of High-Tension Energy on the Continent.

Where hydraulic energy in the immediate vicinity of industrial centres is becoming rather scarce, long-distance power transmission with high voltage is now being resorted to in a great number of cases. A thirty-seven-kilometre (twenty-three miles) transmission at 20,000 volts is being constructed to supply Como with energy. In the vicinity of Zaragosa, in Spain, two plants of 4,000 and 6,000 horse-power, respectively, are being installed. The power obtained will be transmitted at 30,000 volts over a distance of forty-five and eighty kilometres (twenty-seven and fifty miles). The Fure and Morge installation, near Grenoble, in France, is a 7,000-horse-power plant supplying current at 26,000 volts to a number of towns and villages such as Voiron and Moirans, the distance covered being fifty kilometres (thirty-one miles). This plant has been completed and is now working. Other plants are being erected on the Cellina River in northern Italy, the energy being supplied at a tension of 36,000 volts to the towns of Venice, Udine and Pordenone, the current in this instance being transmitted over distances up to ninety kilometres (fifty-six miles).—*Engineering* (London), March 22.

Soot in City Atmosphere.

At a meeting of the British Society of Chemical Industry, Mr. W. Irwin recently gave some interesting particulars respecting the amount of suspended soot in the atmosphere of Manchester. The results were deduced from observations made during a heavy snow-fall which occurred in February. At a point about three miles from the centre of the city a sample of snow which had been lying on the ground for ten days was melted and the dry residue weighed and analyzed. It was found to be equivalent to something over ten pounds per acre, or over three tons to the square mile for ten days, and consisted of 48.6 per cent of carbon, 6.9 per cent of grease and 44.5 per cent of ash. Another sample taken from near the centre of the city disclosed about three times the amount mentioned above, or nearly one ton of soot per square mile per day. These figures show very clearly to what an extent the smoke nuisance is still in evidence in British manufacturing cities, and similar tests taken from some of our middle-western towns where soft coal is burned would probably show a similar or even worse state of affairs. It is interesting to note that at Manchester there is enough grease mixed with the soot to make it stick tightly to the buildings or whatever other objects it falls upon.—*Mechanical Engineer* (London), April 12.

The Dusseldorf Exhibition.

The Dusseldorf Exhibition occupies a tract of land on the right bank of the Rhine thirteen miles long, with an average width of three hundred yards. A circular electric railway has been laid down within the exhibition grounds, the total developed length of which is 2.17 miles, with ten stations, and service on this line will be carried by accumulator cars with or without trailers. The grounds contain 168 special buildings or pavilions. Twelve of these buildings, with an area of 36,000 square yards, are exclusively for technical exhibits. The most prominent structure is the Machinery Hall, 919 feet in length, covering an area of 17,350 square yards. Twelve electric overhead traveling cranes of ten, fifteen and thirty tons lifting power are provided for the erection of engines. The current conductors consist of copper cables. All the cranes are fitted with series motors of high power, which work with continuous current at a pressure of 220 volts. The same motor operates the traveler and the chain pulleys and ensures traveling action of a crane through spur-wheel or helical-wheel transmission. The motor is worked from a cab suspended from the crane in the usual way. The whole of the exhibition ground and most of the buildings are lighted electrically. For this purpose 6,000 horse-power is available, and a total of 6,000 horse-power is also provided for power transmission. The cables have a developed length of nine and one-third miles. The generating plant is located in the front end of the Machinery Hall and consists of twenty-six steam engines of 40 to 3,000 horse-power which can develop together 7,800 kilowatts.—*Engineering* (London), April 18.

Fusion of Quartz in the Electric Furnace.

The great advantage of quartz for use in many kinds of delicate physical apparatus would already have led to its widespread use if it were not so difficult a material to deal with. Up to the present the oxyhydrogen blowpipe has almost exclusively been made use of, but because of the temperature being only a little higher than that of melting silica it is not satisfactory for making apparatus for high-temperature gas research. Le Chatelier and Doufor have proved that the temperature coefficient of quartz is remarkably small, only 0.0000007 between 0 and 1,000 degrees centigrade, and that quartz after being fused may be heated to any degree and plunged into cold water without in the least inclining to crack. In these experiments quartz was fused in an electric furnace. Repeating some of Moissan's experiments, Mr. R. S. Hutton, of Owen's College, Manchester, has quite recently observed that the silica which is not volatilized by the arc remains in a vitreous transparent condition and that no partial reduction of the silica may be feared when a current of air is passed through the furnace. His furnace consists of a low-grooved block of magnesia or lime with horizontal passages for arc

columns in the upper block plate into the groove which is at right angles to the carbon electrodes and fits the support plate of graphitic carbon. A current of 350 amperes at fifty volts melts the finely divided quartz heaped on the support in a minute or so. The quartz should not be too finely powdered. Pure white sand gives a more opaque mass than powdered flint, but the plastic quartz can take up a certain amount of sand without impairing its transparency, and it may be possible to use a preparation of sand or fine quartz for cleaning bulbs or tubes fused in this manner.—*Engineering* (London), April 18.

A Large Steam Turbine.

At Baden, Switzerland, in the shops of Brown-Boveri & Company, tests have recently been made upon a new steam turbine alternating-current generating unit of 5,000 horse-power, which is the largest machine of its kind that has ever been constructed. The machine was built for the municipal electric lighting station at Frankfort, Germany, and is designed to generate single-phase and three-phase current at 2,500 volts. It runs at 1,000 revolutions per minute and the guaranteed consumption is 15.4 pounds of steam per kilowatt-hour, the steam being superheated to 540 degrees Fahrenheit and admitted under a pressure of 200 pounds per square inch. This corresponds to a consumption of 9.24 pounds per horse-power-hour in a piston engine. The same makers are now building a machine of the same power for the fine central station at Milan, Italy, where it will be used as a reserve for the water-power transmission line coming from Monza.—*L'Industrie Electrique* (Paris), April 10.

A New System of Car Heating.

On the western railways of France, upon an electrically operated line running from the Invalides station to Versailles, a system of electric heating for the cars has been introduced which is stated to have given most excellent results. On account of the many stops and frequent opening of the doors of the corridor cars employed it was found very difficult to maintain a comfortable temperature by the use of the usual heaters under the seats or in the sides of the car, which resulted in giving a high temperature to the air about the passengers' heads while leaving their feet subject to cold drafts at every stop. The method employed was to use a small flat plate heater placed between every pair of seats. The seats in these cars are arranged ten on a side facing one another, these being double seats, and between each facing pair a heater about two feet eight inches long by fourteen inches wide was placed flush with the floor and surrounded by a wooden beading. These were connected five in series on the 550-volt current derived from the third rail provided with a thermostat governor, so that their temperature could not rise above 160 degrees Fahrenheit. Each heater consumed one ampere at 110 volts, making the total consumption for the carriage 1,100 watts, the seating capacity being twenty-four passengers with standing room for as many more. It was found during last winter that this system of heating, by which the passengers were able to place their feet upon the hot surface of the heater, exhibited many advantages and was very satisfactory to the traveling public. The daily expense comprising interest and depreciation at the rate of thirteen per cent was three francs (sixty cents) per day per car, while the temperature maintained in the cars was found to be quite sufficient and entirely satisfactory.—*L'Industrie Electrique* (Paris), April 10.

A New Form of Cavendish Balance.

Mr. G. K. Burgess has prepared a study on a new form of Cavendish balance. According to this writer the sensibility of Cavendish's method for the determination of gravitation constants would be much increased if, while still preserving heavy masses hung from the balance arm, the tension which this weight exerts on the suspension wire could be suppressed. This possible, nothing would prevent realizing a measurement as sensitive as might be desired. The attraction between the two systems of spheres—the fixed and moving systems—would remain a definite quantity, and allow increasing the deflection of the movable system by reducing more and more the diameter of the torsion wire. With this object in view the weight of the turning system is compensated by a float immersed in a mercury bath and capillary action that may tend to hinder the mobility of the system is eliminated, and if the zero remains constant under this condition an instrument of unlimited sensibility is secured. A length of twelve centimetres was chosen for the lever arm and from the ends of the balance arm two lead spheres of two kilogrammes each were hung, the whole being buoyed by a cylinder immersed in mercury whose surface was covered by dilute sulphuric acid; a rod passing through the mercury and acid connects the cylinder to the balance. The points of support for the spheres are below the centre of inertia of the system, giving the balance arm the form of three sides of a rectangle. With this arrangement the torsion fibre has to support a weight of only five or ten grammes which allows of using a fine quartz fibre. Besides a gravimeter this apparatus might become accidentally both a magnetometer and electrometer, thus introducing sources of error due to magnetic or electrostatic attractions. These effects are carefully tested for and eliminated.—*The Physical Review* (New York), April.

Catalysis.

The idea and name of catalytic action were introduced into science by Berzelius in 1835, who pointed out that the action of sulphuric acid in this case—*apropos* of Mitscherlichs's work on the formation of ether—was analogous to the action of dilute acids on starch, to the same action of malt extract, to the decomposition of hydrogen peroxide by metals and oxides, and to the action of platinum on combustible mixtures of gases. According to Berzelius, catalytic force appeared to consist essentially in that substances, by their mere presence and not by their affinity, have a power to rouse latent affinities so that compound substances undergo reaction and a greater electrochemical neutralization occurs. Catalytic actions may be divided into four classes: (1) Release in supersaturated systems; (2) catalysis in homogeneous mixtures; (3) heterogeneous catalysis; (4) enzyme action. The first division includes phenomena which may be regarded as fundamentally explained, the best-known case being the crystallization of supersaturated solutions, for example, of Glauber's salt. With the second condition the explanation given for the first class can not here be applied. We get the right standpoint for regarding the new problem by adhering to the condition laid down for all systems that undergo contact action; that is, the system must not represent a stable condition, for such a system can undergo no change after the addition of energy. The best-known case of heterogeneous catalysis is the action of platinum upon combustible mixtures of gases. While previously the chief interest centered around mixtures of hydrogen and oxygen it has now passed for practical reasons to the combustion of sulphur dioxide to sulphur trioxide. The later investigations of enzyme action have brought to light nothing which gives ground for a fundamental distinction. We shall look upon the enzymes, therefore, as catalyses, which arise in the organ during the life of the cell, and by whose action it discharges the greatest part of its duties.—*Nature* (London), April 3.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Recording Volt, Ampere and Watt-meters.

One of the most important factors in the economy and efficiency of any nature of electric service is the use of recording instruments which will show at a glance either by day or night whether voltages have been properly regulated and maintained. Inventors and manufacturers are reserving no effort in their research for, and application of, means whereby these important instruments may be brought more nearly to a condition of perfection.

In the accompanying illustrations are shown some of the types manufactured by the Bristol Company, of Waterbury, Ct., and which have been in service for some time with singular satisfaction. Fig. 1 shows the mechanism of the recording voltmeter for direct or alternating currents. This shows the current coils, one of which is rigidly secured to the back of the instrument. The other is movable and is supported by a pair of frictionless spring knife edges resting in the V-cuts at opposite ends of a shaft through its centre. The pen-arm is directly attached to the right-hand spring and partakes of its motion regarding the change of voltage on a uniformly moving chart driven by a clock designed for this purpose to make one revolution in fifteen minutes, one, six, twelve, twenty-four hours, or once in seven days. The twenty-four-hour charts are most generally used. For recording voltages of currents which are rapidly fluctuating over wide ranges a "damping" device is furnished which renders the instrument dead-beat. A damping device is shown applied to an ampere-meter in Fig. 3.

This instrument is constructed on an electrical balance principle without permanent magnets. The deviations on the chart are generally made on an increased scale in the vicinity of the voltage to be maintained, making it possible to note a variation of one volt. With each recording voltmeter auxiliary resistance is furnished in a separate box which is connected in series with the instrument and is usually located behind the switchboard upon which the recorder is mounted.

Fig. 2 shows the interior construction and operative parts of a recording ampere-meter. The construction is very simple, A being a stationary coil or solenoid through which current passes. B is a very thin disc armature of iron secured to a non-magnetic shaft which extends through the centre of the solenoid, A, and is supported at its opposite ends on steel knife-edge spring supports, C and D. The recording pen-arm, E, is secured directly to the steel spring support, D, and partakes of its angular motion as the armature is attracted to the coil. Although the actual distance that the armature itself moves is small, the angular motion which is transmitted to the pen-arm results in a wide range on the chart without employing multiplying devices between the spring and pen. The armature and moving parts are reduced to a minimum in size and weight to avoid magnetic lag and the effect of inertia when current is thrown off or on.

In Fig. 3 is shown the connection of the damping device where there are extremely large and rapid fluctuations in the current to be recorded as, for example, on an electric railroad. This consists of a box, F, containing oil. An arm, G, is attached directly to the moving armature and carries a light vane which is immersed in the oil.

Fig. 4 shows the construction of a re-

FIG. 1.—RECORDING VOLTMETER, WITH FRONT REMOVED.

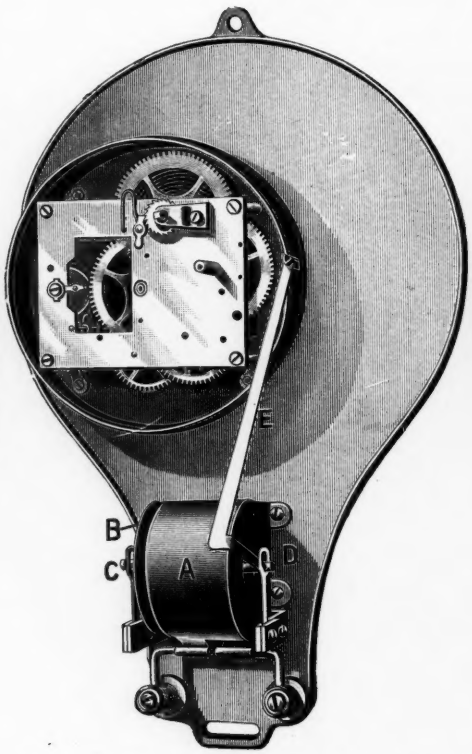


FIG. 2.—RECORDING AMPERE-METER, WITH FRONT REMOVED.

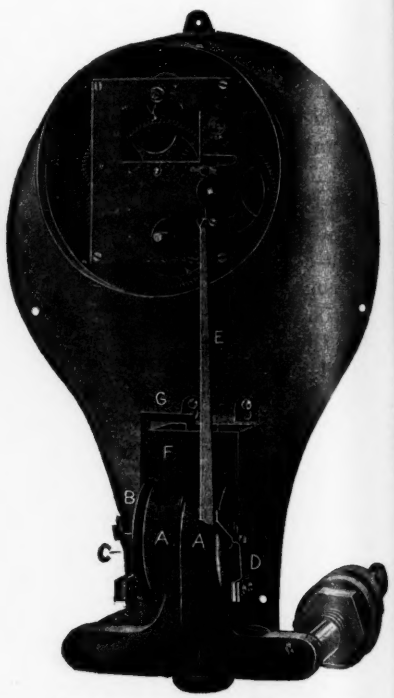


FIG. 3.—RECORDING AMPERE-METER, WITH "DAMPING DEVICE."

cording wattmeter. The coil, A, is wound with thin wire and mounted on knife-edge spring supports, and is free to move toward the stationary coil, B, which is wound with a heavy conductor capable of carrying the entire current to be measured. The terminals of the coil, A, are connected to the positive and negative conductors, and the magnetic effect of the current through this coil of high resistance will be dependent upon the voltage, while the magnetic effect of the current through the coil, B, of low resistance will depend upon the number of amperes passing. The mutual attraction of the coils will be the product of this magnetic force and proportionate to the number of watts. The marking arm, F, is attached directly to the knife-edge support of the movable coil and partakes of its motion regarding

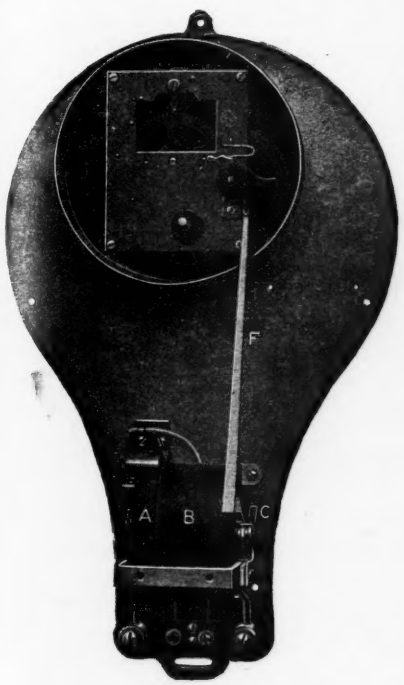


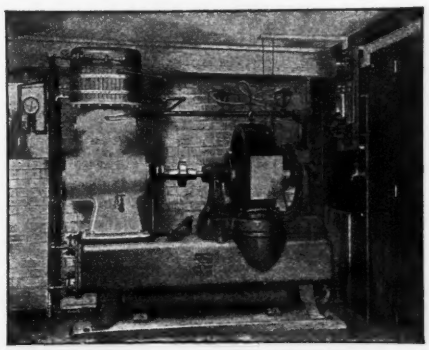
FIG. 4.—RECORDING WATTMETER, WITH FRONT REMOVED.

the variations of electrical energy in a uniformly revolving chart. The magnetic balance principle is employed in the construction, thus entirely avoiding the use of permanent magnets. For direct-current circuits the stationary coil is designed for a current of 1,200 amperes.

These instruments are adapted to all ranges of volts and amperes of direct or alternating current, and make a continuous record, day and night, of total electrical power upon a revolving chart from which can be computed at any moment the time and amount of variation of electrical power.

An Electrically-Driven Refrigerating Machine.

A comparatively recent development in the application of small motors to industrial machinery is that in connection with refrigerating apparatus. The conditions under which these machines are worked require that but little attention be necessary in their operation, and in fact the working parts are so simple that they are almost completely automatic. Two machines, manufactured by the Singer Automatic Ice Machine Company, of Bridgeport, Ct., are here shown.



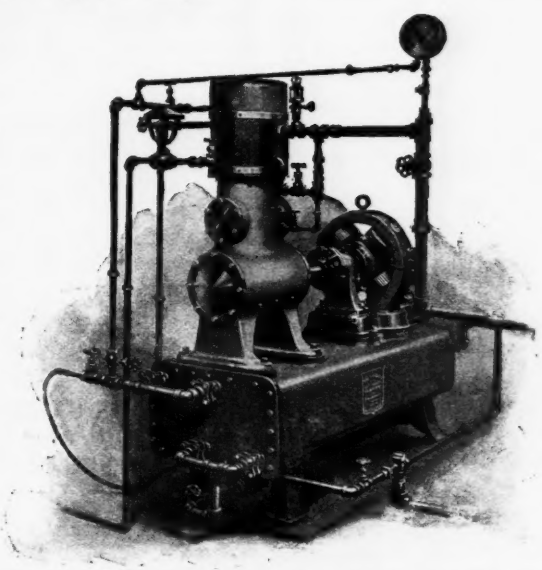
MOTOR CONNECTED TO FIVE-TON SULPHUR DIOXIDE MACHINE, AND CHILL-ROOM.

Referring to the illustrations, Fig. 1 shows an electric motor and thermostat connected with a five-ton sulphur dioxide machine for use in connection with a chill-room which is shown to the right. Fig. 2 shows the electric motor with a one-ton sulphur dioxide machine. In operating the machines shown in Fig. 1 the motor is specially constructed and wound for a low speed. Up to and including the ten-ton size the motor is mounted on the same base as the compressor and is directly coupled. For larger sizes it may be coupled directly or may be mounted on a separate base and belt-connected. The motor runs at 220 volts ordinarily, but is adapted for a current of 110 volts where this is necessary. The thermostat is placed in the chill-room or other place to be refrigerated and acts upon an automatic box so as to stop or start the machine according to the rise or fall of the temperature in the room. With a rise or fall of half a degree above or below the set limit the stopping or starting of the machine is instantaneous and certain, and there is no possibility of any injury to the motor. The automatic box is wound up once a week like a clock. The degree point of the thermostat can be altered as desired. No brine tank, engineer nor attendant is required at any time, as the combination of the thermostatic attachments with the automatic valves is very simple and efficient.

With the machine illustrated in Fig. 2 there is no thermostat used, and in this case the machine is semi-automatic. When desired, a switch is placed in the office or other convenient position and the machine can be started or stopped from this point.

A New Car Coupling.

A car coupling, which has for its object to lessen the space between the cars, is being tried on the line from Berlin to Oranienburg, Germany. It is stated that with this system the distance between the cars has been reduced to seven eight-tenths inches. The buffers are the same as in the old cars, but the springs, which are a little shorter than usual, are built into the cars, thus making shorter couplings possible. The question as to whether the shorter couplings would bring about a danger of collision has been raised, but it appears that careful trials have proved that this is not the case, as the effect at the buffers has not in any wise been changed.



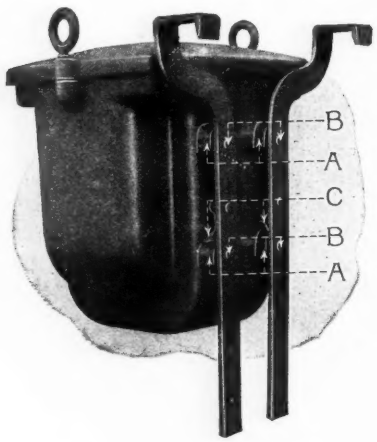
MOTOR CONNECTED TO ONE-TON SULPHUR DIOXIDE MACHINE.

A method of utilizing boiler-furnace clinkers adopted at some works, near Rouen, France, consists in picking out the coal particles and reducing the pieces to the size of a nut, and making a mixture of the substance with slack lime, then moulding the paste thus obtained into bricks and finally drying.

A New Suspension Hook for Transformers.

In detaching an old transformer case on the occasion of installing new apparatus there is sometimes great difficulty encountered in removing the old transformer from the suspension hooks on the pole or building. In most cases this is caused by the rusting of the hooks and in the rusting of the bolt and nut usually employed to fasten the hook to the case. This corrosion is sometimes carried to such a point that it is necessary to use considerable force, and in some cases with damaging results, in making this change.

The Fort Wayne Electric Works, in connection with its new line of type A oil transformers, has introduced what is claimed to be an effective device which overcomes this difficulty and is especially



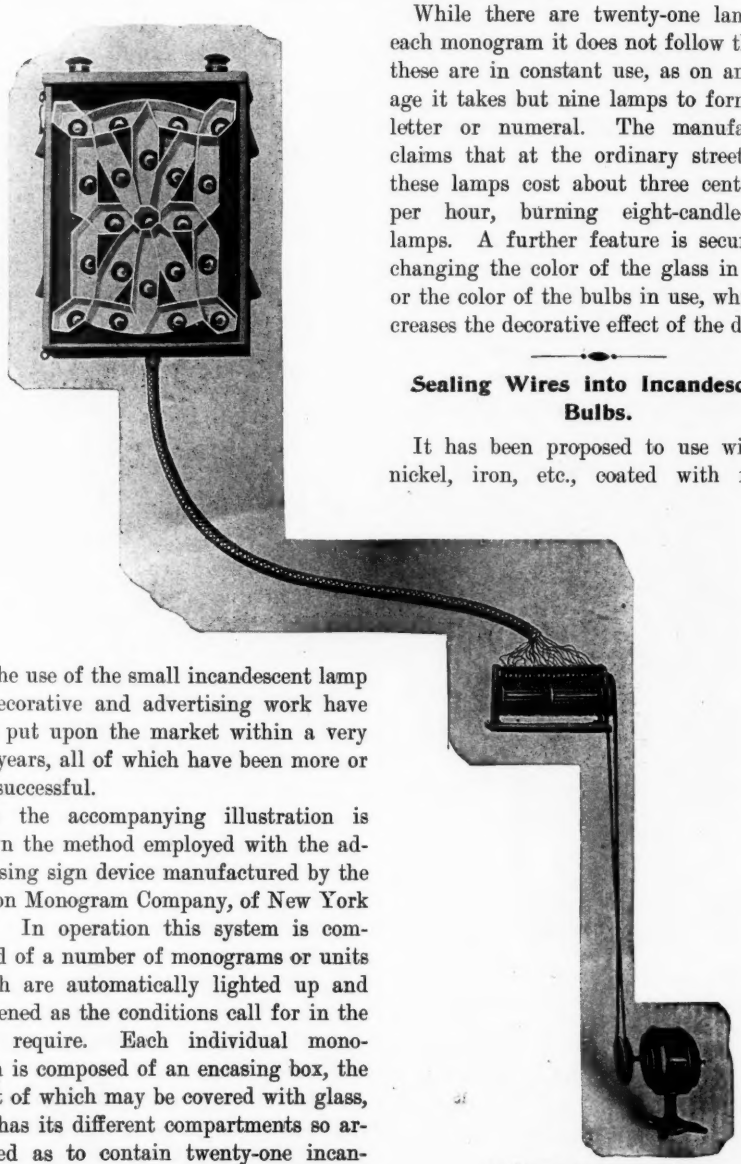
New Transformer Suspension Hook.

convenient in application. The illustration shows the ordinary hooks used in mounting the transformer box on crossarms, etc., but instead of separate machine bolts there are riveted studs on the hook shank which engage in pockets in the lugs and an intersecting cam-lock device.

These permit the hooks to be attached to the transformer before it is elevated to its position, or the hooks can be set in place on the pole and the transformer raised by means of eye-bolts in the case until the pockets AA on the back of the case engage with the rivets or studs BB on the hanger irons. In either case the intersecting cams, C, are driven home with a hammer with just enough force to drive the studs well up into the pockets which rigidly and strongly attach the transformer to the hanger irons. It is claimed by this method that it is very easy at any time to detach and remove the transformer without disturbing the hooks and without the use of tools.

A Novel "Talking Sign."

Probably one of the most useful and interesting uses to which small incandescent lamps have been put is for advertising and decorative purposes. That this application of incandescent lighting is rapidly increasing is very evident from the large number of orders which are being received by standard lamp manufacturers for small units. Numerous forms of lighting boards and apparatus for the use of the small incandescent lamp in decorative and advertising work have been put upon the market within a very few years, all of which have been more or less successful.



A Novel Electric Sign.

In the accompanying illustration is shown the method employed with the advertising sign device manufactured by the Mason Monogram Company, of New York city. In operation this system is composed of a number of monograms or units which are automatically lighted up and darkened as the conditions call for in the sign require. Each individual monogram is composed of an encasing box, the front of which may be covered with glass, and has its different compartments so arranged as to contain twenty-one incandescent lamps. Each monogram is connected with a small rotating machine which is called the commutator, which changes the reading of the sign automatically by being revolved by a small motor. These commutators are about thirteen inches in length and are arranged for forty changes, that is, the wheels are slotted in forty places and filled with what are called letter-bars, which are practically type. These letter-bars may be removed as often as desired and arranged to make another reading of forty changes. The sign will go on repeating forty different words or sentences as long as the electric current is turned on, or it can be used as a stationary sign if so desired. Some signs have ten monograms, some twelve and some as high as fifty. It is evident that enough of these monograms must be ordered to flash at least the longest word which the advertisement or statement calls for.

While there are twenty-one lamps in each monogram it does not follow that all these are in constant use, as on an average it takes but nine lamps to form each letter or numeral. The manufacturer claims that at the ordinary street rates these lamps cost about three cents each per hour, burning eight-candle-power lamps. A further feature is secured by changing the color of the glass in front, or the color of the bulbs in use, which increases the decorative effect of the display.

Sealing Wires into Incandescent Bulbs.

It has been proposed to use wires of nickel, iron, etc., coated with fusible enamel or silica, red lead and potash, and then very carefully tempering, to take the place of platinum leading-in wires. Another method is to at first seal the red-hot wires into the glass without cementing, then to apply a mixture of boiled oil and solution of caoutchouc in carbon bisulphide which is forced into any interstice by exhausting.

Bullock Generators at the Fore River Shipyards.

To the Editor of the Electrical Review:

Sir—In your issue of April 26, 1902, relative to the electrical equipment of the Fore River Ship and Engine Company, at Quincy, Mass., the writer wishes to take one or two exceptions to this article. You state on page 529 as follows:

Another unit of the older plant is a 14 by 25 by 36 Hamilton-Corliss compound engine connected to a Bullock generator of the same class and voltage as that described above. These two machines constitute the old plant, which is used for a reserve and for working nights and Sundays.

You refer to the Bullock generator as of the same class as the sixty-five-kilowatt General Electric. You are in error there as the Bullock generator is a 200-kilowatt and does not constitute the old plant, as this generator, without the use of the sixty-five-kilowatt General Electric generator, has done the entire work of this shipyard up to the present time. The 300-kilowatt General Electric machine which it now has is not yet operating, and will not be for some time.

As this plant was put in in its entirety by the writer, we dislike very much indeed to have our unit described as a sixty-five-kilowatt, and only a reserve for Sundays and working nights.

Geo. H. Berg, Dist. Mgr.,
Bullock Electric Mfg. Co.

Boston, April 26.

Turbines for London Underground Electrics.

Steam turbines are to be adopted in the electric generating station to be built for the Metropolitan Railway Company, of London, the contract having just been given to the British Westinghouse Electric and Manufacturing Company, of Manchester. The latter is now filling a similar contract for the Metropolitan District Electric Traction Company, and as there will be a general similarity in the two stations, it will be easy to arrange for connecting the two and making them interchangeable, as far as the supply of current is concerned, which feature was required by the terms of the franchises of the two roads. The Metropolitan power station will be located at Neasden in the northwest of London, and will contain three sets of 3,500 kilowatts capacity each. The Chelsea station of the Metropolitan District Railway will contain four sets of 5,000 kilowatts each. The electrical machinery for both stations will also be supplied by the Westinghouse company. The current will be three-phase alternating and of 10,000 volts, to be transformed in substations to direct current for use in the car motors. The steam for the immense steam turbines in the District and Metropolitan plants will be generated in water-tube boilers. The aggregate power of the two plants will be 30,500 kilowatts. Both roads are underground, and the change to electric traction will be an important and desirable step in the solution of London's transportation problem.

Improved Type of Transformer Cutout.

The new primary switch and cutout manufactured by the General Electric Company, Schenectady, N. Y., is made of porcelain and is practically a pole-line insulator combined with a transformer primary switch and single-pole cutout; thus the wire may be brought directly from the line to the cutout and thence to the transformer without the use of an additional insulator. The cutout consists of stationary terminals with clips which make contact with a removable porcelain plug which carries the fuses. The construction is such that ordinary uncovered

Improved Transformer Cutout.

fuse wire may be used, although this is not recommended because of the possibility of improper fusing due to the increased length of wire over ordinary practice thus required, which, of course, materially affects the carrying capacity of the fuse. A line of fuses specially constructed for use in this cutout is manufactured.

The plug, when inserted in the cutout, is held securely in position because of the peculiar design of the contact, and the construction of the handle is such as to protect the hand from danger of shock.

The cutouts are finished in black, thus corresponding to the general appearance of the transformers.

Protection of Metallic Tubes in France.

Consul Thornwell Haynes, of Rouen, March 28, 1902, reports that M. Bergier, a Frenchman, has just discovered a composition for protecting metallic tubes against the action of liquids. The composition, says the consul, consists of the following, in pounds: Dry sand, 220.4; potash or soda, 182.9; nitrate of potash, 4.4; minium, 33; pulverized marble, 11; dichromate, 0.22; red oxide of copper, 0.11; regulus of antimony, 0.11. This is applied to the interior of the tube as follows: The vitreous substance is first blown into cylindrical form and is then introduced into the tube, which has been brought to a white heat, the blowing being continued until the composition adheres to the metal. The consul adds that the composition is claimed to have an expansion and contraction equal to that of the metal which it protects.

Farewell Dinner by Mr. E. B. Baker.

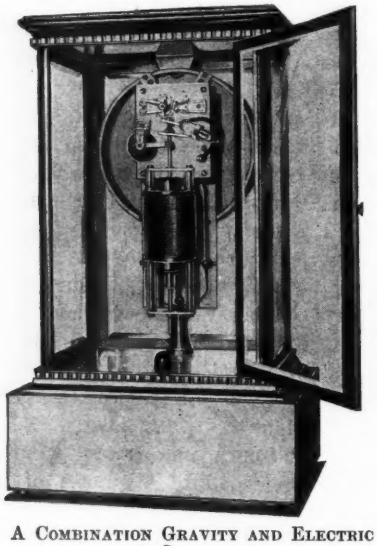
Mr. E. B. Baker, who for about twenty-four years has been the general superintendent of the Southern New England Telephone Company, and who has resigned to enter other business, gave a dinner to a number of his associates and friends at the Tontine Hotel, in New Haven, April 30. The occasion was a very pleasant one, and a number of brief addresses complimenting the host were delivered. Mr. H. J. Pettengill, of the Western Telephone and Telegraph Company, presided, and among the speakers were Mr. M. F. Tyler, president of the Southern New England Telephone Company, and Messrs. W. J. Denver, J. J. Carty, A. L. Salt, W. L. Candee, George T. Manson, G. E. Betts, E. B. Pillsbury and F. M. Barber. On behalf of a number of Mr. Baker's friends Mr. Denver presented to him a beautiful solid silver tea set. Letters of regret were received from Mr. Eugene F. Phillips, of the American Electrical Works; Mr. Thomas B. Doolittle, of the American Bell Telephone Company; General E. P. Meany, of the American Telephone and Telegraph Company; Mr. W. D. Sargent, of the New York & New Jersey Telephone Company; Mr. A. C. White, of the Providence Telephone Company, and Mr. Charles Soby, of the Gray Telephone Pay Station Company.

Mr. Baker is one of the best-known practical telephone men of the day, and his experience as general superintendent of the Southern New England Telephone Company and his highly successful management of the company's interests were subjects that received most favorable comment from all the speakers of the evening. Mr. Baker will hereafter be identified in an executive capacity with the Gray Telephone Pay Station Company and will have his headquarters at 253 Broadway, New York city. The Electrical Review joins with other friends of Mr. Baker in extending best wishes for his success in his new field of work.

An Electric Clock.

An important application of electricity to delicate recording mechanism is that shown in the accompanying illustration. This is a combination of a gravity and electrical timepiece, and in all respects a radical change in clock-making.

As may be seen in the illustration, the application of electricity is in supplying a motive power in the place of the usual spring. In the base of the clock, concealed from view, are two sealed batteries whose capacity is ten ampere-hours. In the place of the spring, and running through the centre of an electromagnet or solenoid is an armature in the form of a rod composed of a magnetic material. This core is suspended from a lever, which is connected to the gear train by means of a small ball clutch guided by standards.



A Combination Gravity and Electric Clock.

The clock starts with the core or armature at its highest point, its own weight carries it downward, and, as it descends, it pulls down the lever with it, which has a sliding motion ensuring uniform driving power, thus giving the driving power to the regular machinery of the clock.

The circuit of the magnetic or solenoid coil is completed by the switch shown above and to the right of the core. It is composed of a glass bulb attached to a pivot and moved by the armature weight in one end of which are the two wires not connected. In the bulb also is a small quantity of mercury, and in its ordinary position the wires are at the top and the mercury at the bottom. When the core reaches the lowest point in its descent, it tips the bulb (with which it is connected) until the end with the two wires is the lower. The mercury completes the circuit, the electromagnet raises the core to its original height, and the bulb assumes its upright position again, thus disconnecting the circuit. By another ingenious device, the driving power of the core is not stopped while it is being raised. There is nothing to wear in the mechanism, as the friction is reduced to a minimum.

The weight takes five and a fraction minutes to make the descent, and the amount of time necessary for the electricity to lift it is less than one-third of a second. The capacity of the batteries, as stated above, is ten ampere-hours or 36,000,000 milliampere-seconds. Every five and one-half minutes the clock requires for one-third of a second 350 milliampere-seconds. As the electricity is only in use during the one-third of a second in which the core is being raised, it follows, therefore, that the batteries contain enough electricity to run the clock for more than 3,000 days. The maker's only guarantee is for three years, however.

One important point in favor of this clock is that as it has no pendulum or spring, it does away with the necessity of a perfectly horizontal base and helps to assure correct time.

This extraordinary clock will cost no more than the spring-driven clock in the various styles of cases for all purposes where accurate time is required.

This ingenious device is known as the En Holm electric clock, patented by Oscar A. En Holm, and manufactured by the Commercial Time Company of America, with offices at 120 Broadway, New York city.

The Preliminary Programme of the National Electric Light Association Convention.

A long list of papers, of varied and peculiarly timely interest, has been arranged for presentation at the twenty-fifth convention of the National Electric Light Association, to be held at the Grand Hotel, Cincinnati, Ohio, May 20, 21, 22. The topics and authors are as follows:

"Rates," Henry L. Doherty, Denver; L. A. Ferguson, Chicago; Alex. Dow, Detroit; L. R. Wallis, Woburn, Mass.; Ralph J. Patterson, Waterville, Me.; Samuel Scovil, Cleveland, Ohio. "Signs and Decorative Lighting," papers by Russel Spaulding, of New York, and E. J. McAllister, of Newark, N. J. "Are Free-Lamp Renewals Desirable," James English, New Haven, Ct.; F. Ellwood Smith, Somerville, Mass.; F. W. Little, Peoria, Ill.; W. J. Greene, Cedar Rapids, Iowa. "What Efficiency Lamp Should Be Used?" Henry L. Doherty, Samuel E. Doane, Marlborough, Mass.; L. G. Van Ness, Denver; Francis W. Willcox, Harrison, N. J. "What Improvement Is Desired in Meters?" Robert Ferris, Monmouth, Ill.; C. A. White, Somerville, Mass.; H. H. Scott, Lincoln, Neb. "Are Loose-Leaf Ledgers Desirable for Electric Companies' Records?" G. E. Tripp, Boston; H. H. Fairbanks, Worcester, Mass.; Geo. W. Davenport, Boston; Charles R. Price, New Bedford, Mass. "The Advantages of Gas Engines," Charles H. Williams, Madison, Wis. "What Changes Should Be Made in the Plan of Uniform Accounting?" J. P. Crowley, St. Paul, Minn. "Caring for Consumers' Complaints," Irvin Butterworth, Denver. "Boiler Firing with Oil," James W. Warren, Los Angeles, Cal.; H. T. Edgar, El Paso, Tex. "Three-Phase *vs.* Two-Phase Distribution," B. A. Behrend, Cincinnati; Charles F. Scott, Pittsburgh. "Hot Water *vs.* Steam Heating," J. F. Porter, Alton, Ill.; P. H. Korst, Janesville, Wis.; C. R. Maunsell, Topeka, Kan. "Does It Pay to Treat Poles with Creosote, Oil or Other Compounds," W. E. Moore, Augusta, Ga. "Gas Explosions in Underground Systems," James Blake Cahoon, New York. "Protection of Long-Distance Transmission Lines," F. A. C. Perrine, Pittsfield, Mass.; L. Denis, Quebec; P. N. Nunn, Provo, Utah; P. M. Lincoln, Niagara Falls, N. Y.; H. J. Gille, St. Paul, Minn. "Present Performance of the 220-Volt Lamp," Fred W. C. Bailey, Columbus, Ohio; "Report of Committee on Photometric Values of Arc Lamps," Henry L. Doherty, chairman. "Question Box."

The following gentlemen form the local reception and entertainment committee: H. C. Hutchinson, chairman; Norman C. Kenan, A. C. Beattie, B. T. Price, J. B. Pevear, O. M. Hall, Thomas Ryan, Samuel Moyer, Samuel W. Glover, Alexander Lewis, H. J. Douds, John A. Devere, J. W. Bullock, Jessie Bindley, Edward Gillette, Wm. S. McCallum, C. B. Humphreys, Frank Lawrence, F. C. Colwell, Frank G. Bolles. This committee has arranged, among other entertainments, visits for the ladies to Rookwood Pottery and Cincinnati Museum of Fine Arts; a trolley ride through the city and suburbs to the Zoological Gardens, where luncheon will be served. The Bullock Electric Manufacturing Company has arranged for the delegates a trip to and through its works.

The headquarters of the association will be at the Grand Hotel; other hotels are the St. Nicholas and the Gibson House.

A special rate of a fare and one-third on the certificate plan for the round trip, from all points in their territory, for delegates and friends attending the convention has been arranged. This rate is good for three days (not including Sundays) preceding and the three days following the adjournment of the convention.

A certificate showing that full fare has been paid going should be secured from the agent. This, when properly *visé* at the office of the secretary of the association, will secure a return ticket at one-third the regular rate.

A number of the delegates have arranged to go in company, leaving New York city at 2 P. M. on Sunday, May 18, over the Pennsylvania Railroad, arriving in Cincinnati on Monday, May 19, at 10.30 A. M.

CURRENT ELECTRICAL NEWS

COMMERCIAL NEWS

DOMESTIC AND EXPORT

A LIMIT TO FIX THE SIZE OF CONDUITS—In Chicago an old section of the municipal code has been unearthed which, it is said, clearly limits the size of conduits to be used for telephone and telegraph companies, and which if the law department holds applicable may bring the work of the Illinois Telephone and Telegraph Company to a standstill until the council acts upon the ordinance now before the judiciary committee. The clause limits the size of conduits for this purpose to two feet wide and two feet deep. Considerable feeling has been stirred up within the board of aldermen over the fact that the telephone company is building a tunnel which it is claimed by certain members is to be put to uses other than telephone work.

AN ITALIAN SYNDICATE FOR WATER-POWER DEVELOPMENT—A Milanese syndicate, with a nominal capital of $16,000,000, is reported to have been formed with a view to acquire anywhere in Europe water rights and to lay down electrical plant in connection with the power so derived. The Bank of Marseilles, which concern is interested in the Continental Water and Electric Power Syndicate and the Mont Cenis Power and Land Company, is said to be financing the Italian concern. Schemes are said to have already been worked out providing for three water-power undertakings in upper Italy, one of 140,000 horse-power and others of 47,000 horse-power and 32,000 horse-power, which, it is estimated, will mean a total expenditure of nearly $11,500,000.

ADVERSE DECISION IN THE TRANSFER ARGUMENT—For violation of the universal transfer ordinance a jury in Justice Gibbon's court in Chicago has imposed a maximum fine of $200 against the Chicago Union Traction Company. The verdict is of unusual importance as it involves the right of street-car patrons to enjoy transfer privileges between connecting lines of the Chicago Union and Consolidated Traction companies within the city limits. It also draws attention to the possible liability of the company for $99,400 in 497 suits pending of a similar character, and it is stated that it will mean an annual loss to the companies which has been carefully estimated at $500,000. An appeal has been taken to the higher court by the Union Traction Company.

BRITISH EDISON COMPANY FORMED—An announcement has been made in London that a company capitalized at $10,000,000, having many prominent persons among the directors and Lord Kelvin as technical adviser, has been formed to mine the iron ore deposits of Dunderland on the west coast of Norway by a new process which has a recently discovered system of ore concentration invented by Thomas A. Edison, and has created the most intense interest among British ironmasters. Until recently there has been no method by which ore of the kind found in the deposits of Dunderland could be commercially concentrated to a point suitable for the furnace. This difficulty, it is said, has been caused by the peculiar nature of the ore, which is a mixture of magnetic ore and hematite. The difficulty has been overcome by the employment of a device, the principle of which is a very powerful magnet which deflects the iron in the crushed ore as the whole is allowed to fall from a chute in front of the magnet. It is said that the machinery is of the simplest character and very economical. Experiments have been carried on for the past eight years upon rock containing less than one-third the proportion of iron found in the Dunderland deposits in order to make it commercially valuable. A full-size working unit of this machinery has been in operation for some time and results have been highly satisfactory.

ELECTRICITY IN CANADA—The annual summary of the use of electricity in Canada, according to Mr. George Johnson the Dominion statistician, shows the number of lighting companies to have increased from 259 in 1898 to 306 in 1901. The arc lights in use increased from 10,389 to 12,800, and the incandescent lamps from 463,615 to 815,676. The use of electricity for lighting purposes has risen sixty per cent. Of the 306 companies, the province of Ontario has 196 or 64 per cent. Quebec has 50, Nova Scotia 21, British Columbia 14, New Brunswick 11, Manitoba 6, Northwest Territories 5, and Prince Edward Island 3. There are 78 cities or towns which have either municipal plants or are supplied by companies. In Quebec 42 cities have electric light plants, in Nova Scotia 20, and in New Brunswick 10. No less than 1,046 miles of electric railways will be added during the years if charters which the legislature has been petitioned to grant are secured. Twelve companies have asked for franchises in the territory extending from Cornwall to Windsor, and if this track be laid there will be a continuous line between these two points with the exception of a short break from Glencove to Tecumseh, while to the north another system will reach from London to Owen Sound, skirting the shore of Lake Huron. It is stated that these railways would revolutionize transportation in the country districts and remote sections and greatly enhance the value of farm products. In the province of Quebec a number of electric railway companies have recently been chartered by the provincial legislature and it is expected that fifty miles will be constructed during the coming summer.

TELEPHONE AND TELEGRAPH

MILWAUKEE, WIS.—The Bloomer Telephone Company has increased its capitalization from $2,000 to $8,000, and will build lines to Cook's Valley, Sand Creek and Cartwright.

NAVASOTA, TEX.—The Shiro Telephone Company is running its line from Shiro to Loma. The post offices and schoolhouses have been connected up and it is expected that a large number of residence subscribers will be secured.

ROYAL CENTRE, IND.—The Home Telephone Company, of Logansport, has contracted for the construction of a toll line from Logansport to this city by way of Lucerne and work has already begun on it. This line will connect with the local line and have its long-distance telephone in the local office.

DETROIT, MICH.—The Cooperative Telephone Company has issued a statement that it expects to put in a plant at a cost of $58,782, with an initial capacity of 1,000, but ultimately prepared to handle 12,000 instruments. A large number of subscribers have paid the assessment, which is not due for some time.

NEWTONIA, MO.—A telephone company composed of local investors has completed the preliminaries for a telephone line to extend from Granby to Newtonia, Ergo and Newstead, where it will connect with other lines, and finally unite with a general line, giving Newtonia telephone connection with all adjoining counties.

SALISBURY, MD.—The Diamond State Telephone Company is making extensive improvements to its lines in Wicomoco and Somerset counties from Delmar to King's Creek and Crisfield. As soon as the work on the line from King's Creek and Crisfield is completed a new line will be started from Salisbury to Ocean City, to be built and in operation by the opening of the summer season.

BALTIMORE, MD.—Mr. Garry Brown, auditor of the Chesapeake & Potomac Telephone Company, with offices in the Calvert Building, has left Baltimore to join the Bell Telephone Company with headquarters in Boston. He will be succeeded in Baltimore by Mr. A. P. Crenshaw, superintendent of construction and acting auditor. Mr. Crenshaw has been connected with the company as superintendent of construction and general manager of outside work for the past twenty-five years. His place will be filled by Mr. W. A. Tower, of Montreal.

LEGAL NOTE

INFRINGEMENT PATENT SUIT—Dan W. Simms, of Stuart, Hammond & Simms, representing Frank B. Cook, former president of the Sterling Electric Company, has filed in the United States court at Indianapolis six suits against the Sterling Electric Company. It is said that the six suits are based upon infringements of six patents. The purpose is to secure an injunction against the use of these patents and to compel an accounting for the profits realized upon sale of goods made thereunder. It is contended by Mr. Cook that more than $300,000 of goods has been made and sold under patents belonging exclusively to him, none of which patents is covered by or mentioned in the license executed by Mr. Cook to the company. Suits will be instituted in the near future upon every patent claimed by the company and not covered by the license referred to above.

ELECTRIC RAILWAYS

HOPKINSVILLE, KY.—A movement is on foot having for its object the construction of an electric railway from Clarksville, Tenn., through this city to the Empire coal mines and other coal fields in North Christian County.

ARDMORE, PA.—The work of construction on the new trolley road from Llanerch to Ardmore is progressing and considerable track has already been laid. Arrangements are being made to have the road completed and ready for travel on May 20.

AUGUSTA, GA.—Splendid progress is now being made on the Aiken-Augusta trolley line by the large construction gang now employed near Clearwater, and it is believed that the entire road will be completed and ready for use not later than July 1.

URBANA, OHIO—The Urbana, Mechanicsburg & Columbus Electric Railway Company has resumed work on its line and it is expected that cars will be running to Dublin before the end of the summer. The principal work consists in the construction of three large bridges, one at Dublin avenue, another at Plain City, and one at Hayden's Falls.

NEWPORT, OHIO—The preliminary survey for the Newport & Alexander Traction road has been completed from Alexander to Sixth and Iowa streets in Newport, and estimates will be furnished for the cost of building the road to the capitalists who are expected to purchase the bonds in a few days. The route, leaving Alexander Pike at Fort Thomas, passes the Metcalf Place, and crosses over to the head of Three Mile Creek.

AUGUSTA, ME.—Work has been commenced on the Augusta, Winthrop & Lewiston Electric Railway at the Augusta end of the line. The promoters believe that the road to Winthrop will be completed by the middle of July. The contemplated route will go through a populous section, and will connect Lake Cobbossecontee, to which in the summer there is a great deal of travel. In another year the road will be completed to Lewiston.

HOMESTEAD, PA.—The Homestead & Mifflin Street Railway Company, financed by business men of Homestead, Pittsburg and vicinity, has recently begun the construction of a line from Homestead, Pa., to Lincoln Place, in Mifflin township, a distance of three and a quarter miles. It will cost $100,000, and is expected to be in operation by July 1. Later additions will be built to the road. Next spring a branch will be constructed to Whitaker, the residents of which now have no street car facilities. This branch will cost $75,000, $33,000 of which, according to an estimate, will be needed for erecting a bridge across Whitaker run, in Munhall Hollow. The bridge will be about seventy feet high. The Laclede Car Company, of St. Louis, has been awarded the contract for the cars. Westinghouse motors will be used and the cars will be equipped with the Westinghouse magnetic brake.

ELECTRIC LIGHTING

BATAVIA, N. Y.—The Consolidated Gas and Electric Light Company, of Batavia, has decided to entirely rebuild and refit its plant so that it will be up to date and efficient.

ALAMEDA, CAL.—A proposition to purchase the city electric light plant has been made, an offer of $125,000 being recorded. It is probable that this will be submitted to the voters for determination.

NASHVILLE, TENN.—The Tennesse Copper Company has decided to erect a power-house and put in an electric light plant at Buna Buna. It has agreed to furnish lights for the principal town in the Ducktown Basin, Hiwassee.

NORTH GALVESTON, TEX.—It is announced that the North Galveston Improvement Company will install an electric lighting plant to illuminate the beach and the 800-foot pier. A line of electric cars from Edgewater to the town is also talked about.

HOOSICK FALLS, N. Y.—The Hoosick Falls Electric Company is rebuilding its entire wiring system in this village. The company is putting in new junction boxes along the system at frequent intervals, and many other improvements are contemplated which will be made later.

FORT EDWARD, N. Y.—A meeting has been held by several merchants of Fort Edward, and the subject of building a new and up-to-date electric light plant has been discussed. Committees have been appointed to ascertain the cost of such a plant and to notify the trustees in regard to street lighting, and to the matter of incorporating such a company.

ESCANABA, MICH.—An electric lighting plant is to be erected in Escanaba by the Chicago & Northwestern road, and experts are now looking over the ground with a view of making specifications for the machinery required. The plant will furnish light for the company's four big ore docks, and also for the coal docks, shops, yards and offices.

SAN ANTONIO, TEX.—At a special meeting of the city council a resolution was adopted instructing the Mayor to submit to the voters of the city, at a special election to be held May 10, the question of whether or not the franchise for an electric light plant be adopted by the people, the franchise in the event of its being adopted to be granted to the party making the best bid for it.

PENN YAN, N. Y.—The company which controls the gas plants at Penn Yan, Ithaca, Little Falls, Oneida, Hornellsville and other points throughout Central New York, has just secured control of the stock of the Canastota Electric Light and Power Company. The company has now opened headquarters at Ithaca. George S. Sheppard, of this place, will act as counsel for the consolidated company.

ST. PAUL, MINN.—The Mangato & St. Paul Electric Railway and Lighting Company has filed articles of incorporation, with a capital stock of $300,000. The company proposes to furnish light and power as well as transportation facilities, and will build a line from Mangato to Kasota, St. Paul and other points. The officers are: W. L. Hickson, president; W. D. Wheeler, vice-president; A. E. Clark, secretary, and W. G. Hoerr, treasurer.

DENVER, COL.—The Denve Gas and Electric Company has confessed judgment in a suit brought by Dennis Sullivan to collect a note for $15,000, and on application of Plaintiff H. L. Dougherty was appointed receiver for the company. The company is capitalized for $3,500,000, of which $2,650,000 is outstanding. It has authorized an issue of $5,500,000 gold bonds, and is responsible for $2,300,000 of six per cent bonds now out. Its available cash assets are $250,000, and liabilities $500,000.

NEW INCORPORATIONS

FRANKFORT, KY.—Citizens' Electric Light and Power Company, of Carlisle. $12,000.

ALBANY, N. Y.—Seneca River Power Company, Syracuse. $100,000. Directors: L. W. Emerick, Fulton; S. B. Storer and R. E. Drake, Syracuse.

CHICAGO, ILL.—United Water and Light Company, Chicago. Capital, $200,000. Incorporators: Waldo F. Tobey, Gail Dray and George C. Madison.

DENVER, COL.—Central Electric Company, Colorado Springs. Incorporated by W. S. Boynton, Robert G. Mullen and Frank E. Boynton. Capital stock, $15,000.

COLUMBUS, OHIO—The Elyria Southern Telephone and Toll Company, Elyria, from $20,000 to $40,000. The Ada Telephone Exchange Company, Ada, from $30,000 to $75,000.

MADISON, WIS.—The McFarland Telephone Company, of the village of McFarland. $2,500. Incorporators: E. N. Edwards, W. G. MacLachlan, Frank Siggelkow and M. D. Larson.

NASHVILLE, TENN.—The Jackson Home Telephone Company, Madison County. Capital stock, $110,000. Incorporators: James L. Dunn, James D. Lloyd, R. F. Spragins, J. H. Hoffman and W. D. Nelson.

COLUMBUS, OHIO—The Interstate Telephone Company, Cincinnati; $20,000. The Stryker Telephone Company, Stryker; $10,000. The Upper Sandusky Telephone Company, increase in stock to $30,000.

SPRINGFIELD, ILL.—Bloomington Electric Light Company, Bloomington, had its number of directors increased from five to seven. People's Telephone Company, Chillicothe, capital stock was increased from $4,000 to $10,000.

GUTHRIE, OKLA.—Topeka, Lawrence & Kansas City Electric Railway Company. $2,000,000. Officers: J. B. Adams, H. M. Levan, R. Levan, T. S. Salathiel, Independence, Kan., and M. L. Adams and E. R. Salathiel, Oklahoma City.

ALBANY, N. Y.—The Addison & Bath Cooperative Telephone Company to connect the towns of Addison, Bath, Risingville, Bonny Hill, Campbell, Sarona, Cameron, Rathbone, Woodhull, Thurston and Bath, Steuben County, with a telephone line. Capital, $4,000. Directors: William V. Crineling, M. A. Angst and Andrew Shanyer, of Thurston, N. Y.

ELECTRICAL SECURITIES

Sensational developments, being for the larger part adverse in nature, have marked speculation in Wall street during the past week. The most spectacular events have been the collapse of certain industrial and railroad securities which have been prominent by reason of extremely sharp rallies in the past few months. While these conditions have all along been regarded as artificial to a considerable degree, and the outside elements have been prepared for a fall, the collapse of last week is not in any way reassuring to this body of investors, to which the market at all times would show an inviting front. Of course any extended bull movement, such as the stock market has experienced recently, is certain to bring about undue and unwarranted inflation in certain quarters which must later be corrected. For this reason the recent contraction is to be regarded as a favorable development in so far as the general market's stability is concerned.

The development in the coal situation will exert a decided influence in shaping speculation in the immediate future. Although the advices which have been received from labor interests might show an alarming condition of affairs, statements which are said to come from high, authoritative sources are to the effect that there will be no anthracite coal strike and this has materially aided conditions.

ELECTRICAL SECURITIES FOR WEEK ENDING MAY 3.

New York:	Closing.
Brooklyn R. T.	67½
Con. Gas	224½
Gen. Elec	323
Kings Co. Elec	200
Man. El	133
Met. St. Ry	150½
N. Y. & N. J. Tel. Co	172½
Westinghouse Mfg. Co	233

At a meeting on May 5, the capital stock of the General Electric Company was increased to $45,000,000.

Boston:	Closing.
Am. Telep. & Tel	179½
Edison Elec	270
Mass. Elec. pf	99
New England Tel	148
Western Telephone & Telegraph	101

The annual report of the New England Telephone and Telegraph Company for the year ending December 31, showed net earnings to be $1,037,482, an increase of $140,730 over last year. The expenditure for new construction amounted to $2,030,092. During recent years the annual charge for maintenance of the plant, including new construction, has amounted to slightly more than one-third of the gross revenue from all sources. The number of stations added to the exchange lists were 17,048, making a total of 84,582.

Philadelphia:	Closing.
Elec. Co. of America	7½
Elec. Stor. Bat. c	90
Elec. Stor. Bat. pf	92
Philadelphia Elec	5¾
Union Traction	43¼
United G. I. Co	122

Electric Storage common swept up from 82½ to 95, but this rapid pace will probably be retarded somewhat in future developments. The annual meeting of the United Gas Improvement Company will authorize an increase of the capital stock. The Union Traction stockholders will also meet to approve the lease to the Philadelphia Rapid Transit Company and authorize the issue of $1,500,000 to fund the floating debt.

Chicago:	Closing.
Chicago Edison Light	175
Chicago Telep	175
Metropolitan El. pf	90¼
National Carbon	25¼
National Carbon pf	91¼
Union Traction	20½
Union Traction pf	56

Union Traction fell off about a point and a half owing evidently to the adverse decision in the third transfer case. Metropolitan Elevated traffic reports for April show a daily average of 109,246 passengers, a gain of 12,228 as compared with the corresponding month last year. The annual report of the Chicago Edison Company for the fiscal year ending March 31, 1902, shows a surplus over and above fixed charges and dividends on the stock amounting to $268,824, and that of the Commonwealth Electric Company a balance in excess of bond interest of $104,502.

AUTOMOBILE NOTES

LONG AUTOMOBILE TRIP—Two correspondents of *Le Matin* have left Paris to make a journey to St. Petersburg. They expect to arrive in St. Petersburg on May 17 in time to report President Loubert's visit to the Czar.

OPENING FOR AUTOMOBILES IN JAPAN—Consul C. B. Harris, of Nagasaki, under date of March 17, 1902, writes: "It is likely that a cheap automobile, holding one person, to take the place of the jinrikisha (made of the same width), would find a ready sale in Japan. There were, on the first of April, 1901, 210,588 jinrikishas in use in the empire, 193,249 being made for seating one person and 17,339 for two."

BRAKING TESTS FOR AUTOMOBILES — A series of interesting tests in showing the rapidity with which an automobile could be stopped was given during the week at Riverside Drive and 109th street. The event was held under the auspices of the Automobile Club of America, and besides the automobiles, tests of quick stopping were made with horse-drawn vehicles. Most prominent of the latter was a four-in-hand coach, which, driven at the rate of 16.3 miles an hour, was stopped in 77 feet 6 inches. A victoria going at 13.8 miles an hour was stopped in 61 feet. One of the best stops of automobiles was made by a gasoline carriage, which, in the 20-mile test, stopped in half an inch under 35 feet, turning completely around as it did so. A French gasoline vehicle, going at 18.9 miles, was stopped in 34 feet 6 inches, and another gasoline vehicle came to a full stop in 29 feet 2 inches, going at the same speed as the French carriage. A steam carriage, going at 7 miles an hour was stopped in 5 feet 9 inches. A large crowd watched the interesting tests. A number of officers from the Automobile Club were present, and others among the guests were Lewis Nixon, President William R. Wilcox, of the Park Department; George Cromwell, president of the Borough of Richmond; Brigadier-General Smith, H. E. Buell and S. S. Wheeler.

PERSONAL MENTION

MR. M. K. EYRE has been appointed manager of the sales department of the Buckeye Electric Company, Cleveland, Ohio.

MR. H. H. GEARY will now have the management of the sales department of the Fostoria Incandescent Lamp Company, Cleveland, Ohio.

MR. GEORGE T. HANCHETT has removed his office from 123 Liberty street to 116 Nassau street, New York city, where he has increased his facilities for making electrical tests very materially and where he will continue to conduct his business of consulting electrical and mechanical engineer.

MR. F. J. KINGSBURY, JR., has been elected treasurer of the Bridgeport Brass Company to fill the vacancy caused by the death of Mr. N. M. Beach, and Mr. W. F. Malloy, of the New York office of the company, 19 Murray street, has been elected secretary to take the place made vacant by the election of Mr. Kingsbury to the treasurership.

MESSRS. W. C. WHITNEY, H. P. Whitney and T. F. Ryan, accompanied by H. H. Vreeland, president, and N. S. Starrett, chief engineer of the Metropolitan Street Railway Company, made up a party which visited the works of the Stanley Electric Company on Thursday, May 1, when they were shown through the plant by Dr. F. A. C. Perrine.

MR. N. M. GARLAND, formerly representative in the northeastern states of the Emerson Electric Manufacturing Company, St. Louis, Mo., and who is well known among the electric fraternity in that section, has assumed the management and control of the New York office of the Ohio Brass Company, Mansfield, Ohio. Mr. Alfred B. Edes, formerly manager of this office, has been appointed sales manager of the company and will hereafter be located at the main office at Mansfield, Ohio.

MR. E. F. PECK.

MR. E. F. PECK has resigned from the Edison Electric Illuminating Company of Brooklyn to accept the position of manager of the illuminating and power department of the Schenectady Railway Company, of Schenectady, N. Y. Mr. Peck on his retirement from the Edison company was presented by his former employés with a handsome solid silver coffee service, as a token of their high esteem. Mr. Peck has been closely indentified with electric lighting interests in Brooklyn for the past seventeen years, and previous to that was for five years in the employ of the Thomson-Houston Electric Company, having accepted a position with that company in 1880.

INDUSTRIAL ITEMS

THE COLUMBIA TELEPHONE MANUFACTURING COMPANY, of Chicago, will remove its factory to Ottawa, Ohio.

THE KEYSTONE TELEPHONE COMPANY, Philadelphia, Pa., is issuing a handsome folder to prospective patrons, stating its position and possibilities.

THE STANLEY INSTRUMENT COMPANY early in May will remove its New York office, under the management of Mr. Francis H. Wall, to 158 Broadway.

THE WILLARD STORAGE BATTERY COMPANY, 49 Wood street, Cleveland, Ohio, is the successor to Sipe & Sigler in the manufacture of the Willard storage cells.

THE UEHLING-STEINBART MANUFACTURING COMPANY announces the removal of its Carlstadt and New Brunswick plants on May 1, 1902, to Passaic, N. J.

THE AMERICAN ELECTRICAL HEATER COMPANY, Detroit, Mich., is presenting its friends with a neat blotter advertising its "Pioneer" electric soldering irons.

THOMPSON, SON & COMPANY, dealers in first-class second-hand electrical machinery, have removed to new offices at 114, 116 and 118 Liberty street, New York city.

THE ELECTRIC CONTROLLER AND SUPPLY COMPANY, Cleveland, Ohio, manufacturing and consulting electrical engineers, will soon move into new and larger quarters.

THE PHOENIX ELECTRIC MANUFACTURING COMPANY, Mansfield, Ohio, successor to the Card Electric Company, has recently perfected a type of self-starting motor which reaches full speed in four seconds.

THE MENOMINEE ELECTRIC MANUFACTURING COMPANY, Menominee, Mich., has placed on the market a new type of fan motor. Mr. John W. Brooks, 130 West Jackson Boulevard, is this company's Chicago agent.

THE INTERNATIONAL MOTOR CAR COMPANY, through its Waverley Department, is presenting its friends with a handsome illustration of an electric runabout operated by two splendidly gowned female passengers.

THE HUNTER FAN AND MOTOR COMPANY, Fulton, N. Y., has perfected a new type of the Tuerk alternating-current ceiling fan which has four blades instead of two; this type may be had with or without chandelier in any of a half dozen finishes.

THE BUCKEYE ELECTRIC COMPANY, Cleveland, Ohio, has recently added very materially to its equipment and enlarged its plant. The present output is 10,000 lamps per day, which has been rendered necessary by the increasing demand for Buckeye lamps.

THE STANDARD POLE AND TIE COMPANY, with offices at 44 Broad street, New York city, is distributing a small folder describing its juniper poles. During the past year the company has delivered over 20,000 of these poles for use in trolley, electric light and telephone work with great satisfaction.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., general selling agent for the Gutmann integrating alternating-current wattmeter, is sending out a new meter catalogue. The unique feature of this meter is in its being accurate, independently of the character of the load, whether inductive or non-inductive.

THE FOSTORIA INCANDESCENT LAMP COMPANY, Cleveland, Ohio, lamp and glass works, Fostoria, Ohio, is now manufacturing sixty-one different styles of inner globes. It is the intention of this company to manufacture every style of globe for which there is any demand, in an effort to make good the claim that it is headquarters for this line.

THE AMERICAN INSULATED WIRE AND CABLE COMPANY, 241 to 247 South Jefferson street, Chicago, received recently an order for 500 miles of No. 12 hard-drawn copper wire from the Chicago Telephone Company. A number of smaller orders had been filled for the same company, and this seems to be thorough evidence of the satisfaction given.

THE CAROLINA LOCUST PIN AND MICA COMPANY, Franklin, N. C., has been incorporated by N. S. Thomas, Porter Dunlap and Charles M. Baume. This company is the successor of N. S. Thomas & Company, and will increase the capacity to 25,000 pins per day. The mica department will make a specialty of mica for the electrical trade in large or small lots in any form desired.

THE SPRAGUE ELECTRIC COMPANY, New York city, has been awarded the contract for furnishing all the electric motors and generators to be used in the cement works at Hannibal, Mo. The order was given by the Atlas Portland Cement Company, which is the largest cement manufacturing company in the world, and the equipment consists of three 400-kilowatt, engine-type, split-pole generators and over seventy motors, ranging in sizes from 15 horse-power to 125 horse-power.

THE GOULD STORAGE BATTERY COMPANY, New York, N. Y., has closed a contract for the second battery for the Pittsburg, McKeesport & Connellsville Railroad, Pittsburg, Pa., to be installed at the Connellsville station. This is a duplicate of the battery at the Uniontown station of the same road and has a capacity of 171 kilowatts. It will be used for the present as a floating battery on the direct-current system. The contract calls for the increase up to 212-kilowatt plate capacity and 318-kilowatt tank capacity, when it will be used in connection with rotary transformers.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, Pa., has recently closed contracts for the installation of chloride accumulators with the Edison Electric Illuminating Company of Brooklyn, N. Y.; Detroit United Railway; Kansas City & Leavenworth Railroad Company; Wolvin Building, Duluth; Society for Crippled Children Hospital; residences of Alfred Gwynne Vanderbilt, Newport; C. Ledyard Blair, Far Hills, N. J.; Bayard Thayer, Lancaster, Mass., and R. B. Angus, Sinneville, Quebec. An increase in the plants of the Peekskill Traction Company; Union station, Brooklyn, and the residence plant of J. D. Rockefeller has been contracted for, and also batteries in several yacht plants.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, Pa., has recently sold two rotary converters of 300 kilowatts each to the Manchester (N. H.) Traction, Light and Power Company. They will be located at Mooksett, N. H., and will deliver power for the operation of the Concord & Manchester branch of the Boston & Maine Railroad, this road having entered into a contract for power with the Manchester Traction, Light and Power Company. The machines are to be supplied with three-phase alternating current and will deliver direct current at 600 volts. The Westinghouse company has also recently sold two rotary converters to the South Covington & Cincinnati Street Railway Company, one being of 200-kilowatt capacity and the other of 400-kilowatt capacity.

THE CHARLES E. DUSTIN COMPANY, New York city, has issued for Mr. Daniel Killion the following circular letter: "I wish to advise my friends and acquaintances that I have severed my connection with Rossiter, MacGovern & Company, and have accepted the position of manager of the Charles E. Dustin Company, at the above address, where I am in a position to supply all wants for electrical machinery of every description, both for railway service and for lighting, steam engines and boilers of any size. Also all forms and types of railway motors, street cars, controllers, etc. From time to time I shall take the liberty of mailing you our bulletins giving brief description of the various forms of apparatus we have for sale. We shall be constantly in the market to purchase machinery of all kinds, and would esteem it a favor if you will give us an opportunity to purchase anything you may have for disposal."

THE ALLIS-CHALMERS COMPANY, Chicago, Ill., has made some important engine sales recently. Among those might be mentioned: Virginia Electrical Railway and Development Company, Richmond, Va.; one 20-inch and 40-inch by 42-inch steeple compound direct-coupled Reynolds-Corliss engine. The Milwaukee Electric Light and Railway Company, Milwaukee, Wis.; two 28-inch and 60-inch by 40-inch vertical cross-compound direct-coupled Reynolds-Corliss engines. Milwaukee Harvester Company, Milwaukee, Wis.; 22-inch and 44-inch by 42-inch 1890 frame cross-compound direct-coupled Reynolds-Corliss engine. Southern Cotton Oil Company, New York; one 18-inch by 48-inch girder frame Reynolds-Corliss engine, one 18-inch by 42-inch girder frame Reynolds-Corliss engine, six 16-inch by 42-inch girder frame Reynolds-Corliss engines, two 16-inch by 36-inch girder frame Reynolds-Corliss engines, one 14-inch by 42-inch girder frame Reynolds-Corliss engine, one 14-inch by 36-inch girder frame Reynolds-Corliss engine. P. L. Kimberly, W. Dreyfus and A. E. Nusbaum, Wyoming; one 14-inch and 24-inch by 42-inch tandem compound non-condensing Corliss engine.